SONA-GRAPH MODELS 661B & 661BC

INSTRUCTION MANUAL

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Issue A

SONA-GRAPH

AUDIO SPECTRUM ANALYZER

Models 661-B & 661-BC

KAY ELECTRIC COMPANY

Pine Brook, N.J.

CApital 6-4000

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SECTION I
GENERAL INFORMATION

1-1 INTRODUCTION

The Sona-Graph is an audio spectrograph which permits detailed analysis of the frequency and amplitude components of complex signals. A sampling technique is used, in which the signal to be analyzed is first recorded on the turntable, and then played back to produce a graphic record on current-sensitive paper wrapped around the recording drum. Time is represented along the horizontal axis, frequency along the vertical axis, with amplitude represented by light and dark shading on the recording paper.

Input signals within the frequency range of 85 to 8000 cps may be analyzed. Three types of visual displays may be produced. The first of these (a) relates frequency and intensity to time; the second (b) relates intensity (over a wider dynamic range than the first) to frequency at any selected time; the third (c) relates the average available amplitude to time. This third type of record requires the use of auxiliary equipment (Kay Amplitude Display).

The recording drum is mounted coaxially on the turntable, on whose periphery a continuous magnetic recording film is deposited. This arrangement provides automatic time synchronization. Any selected 2.4-second interval can be recorded and then scanned at a higher speed during the analysis process. The reproduction of the original signal sample, which results from the scanning, is applied to a heterodyne-type frequency analyzer. Two bandpass filters are provided; one 45 cps wide, and the other 300 cps wide. The first of these emphasizes frequency resolution; the second, time resolution. Selective agc is employed during analysis to compress the intensity range to fit the intensity capabilities of the recording paper. High-frequency response shaping circuits can also be switched in so that low-intensity, high-frequency energy can be recorded as well as high-intensity, low-frequency components. The filter selector control and a VU meter are mounted on the panel. A monitoring loudspeaker and volume control permit the recorded signal to be reproduced aurally. After analysis of a given sample is completed, it may be erased and another sample recorded.

The graphic record is produced as the stylus advances upward along the recording drum, and at the same time changes the apparent center frequency of the analyzing bandpass filter. A high-frequency current applied to the stylus is varied in amplitude proportional to the amount of energy passed by the bandpass filter. It is this current which 'burns' the recording paper and produces the graphic record. In normal operation, the reproduction speed is approximately 3-1/3 times faster than the recording speed.

1-2 PHYSICAL DESCRIPTION

The Sona-Graph consists of 3 basic units; the mechanical unit (Recorder), electrical unit (Amplifier-Analyzer), power supply (and console, if the Sona-Graph is so ordered). The console is not supplied when the equipment is to be rack mounted (Model 661-B), in which case each of the 3 basic units are housed in individual metal cabinets. Units furnished in cabinets are interchangeable with those furnished in console (Model 661-BC), and may be rack mounted after removal of the cabinet. (A separate panel, P/N 7482, is required to rack mount the Recorder unit if the unit is originally procurred in a cabinet. Fig. 1-1.

1-3 EQUIPMENT SUPPLIED

Seven cables are normally supplied with the Sona-Graph when furnished for rack mounting; 8 when furnished in console. (See Section 7-1a for listing of cables). An Altec-Lansing 633A dynamic microphone and 250 sheets of non-photographic Sonogram recording paper and Sectioner Micrometer plate are furnished. The 12-inch drum is optional. Other cables, connectors and auxiliary equipment referred to in this manual are not furnished.

1-4 WEIGHTS AND MEASUREMENTS

When the Sona-Graph is assembled in the console it is approximately 22-3/8 inches wide, 19-5/8 inches deep, and 57-1/2 inches high. The assembled equipment weighs approximately 215 pounds.

When the equipment is assembled for rack mounting the Recorder is 18-1/2 inches by 10-3/4 inches by 17 inches, and weighs 73 pounds; the Amplifier-Analyzer is 10 inches by 19-1/2 inches by 13-3/4 inches and weighs 23 pounds; the Power Supply is 19 inches by 8-1/2 inches by 9-3/4 inches, and weighs 31 pounds.

1-5 UNPACKING AND INSPECTION

After removal of packing cases and protective paper wrapping, the equipment should be visually inspected to determine that no outward signs of shipping damage exist. A careful check of packing case contents should be made to insure removal of all items shipped. Shortage or damage should be reported immediately to the Carrier and Kay Electric Company, or the Kay representative in your area.

To prevent damage during shipment the Record-Off-Reprod shift lever, turntable, and record and reproduce heads are locked in place. These must be freed before operation is attempted.

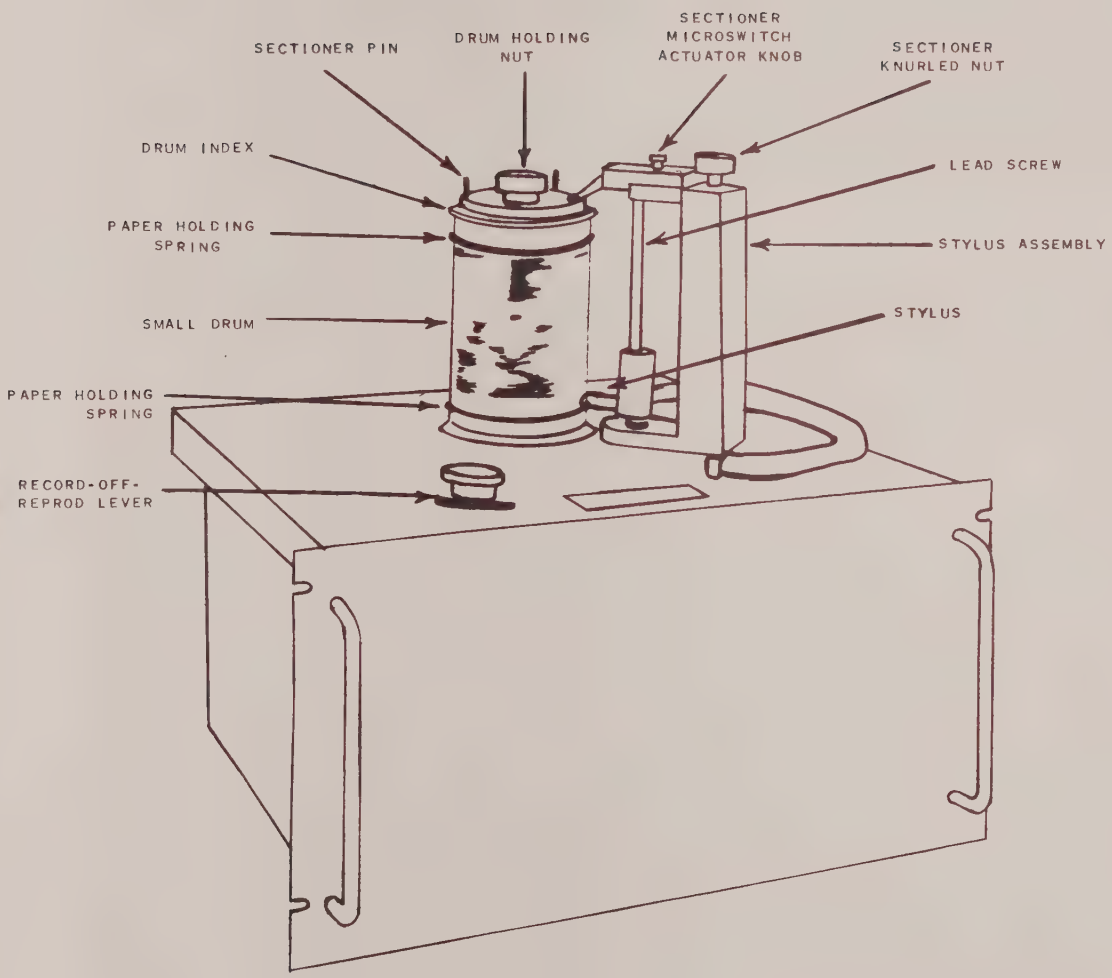


FIG. 1-1, RECORDER UNIT FOR RACK MOUNTING (4-INCH DRUM INSTALLED).

a. To free the Shift Lever, remove the knob, using a #10 Allen wrench. Lift off the red Locking Plate, located under the knob, and replace the knob.

b. To free the turntable, loosen the turntable knurled-head locking screw (located at the base of the stylus housing). Do not remove the screw entirely.

c. To free the record and reproduce heads, remove the four 4-40 screws from the cover plate over the heads. Carefully remove the packing material from the heads and replace the cover.

1-6 SPECIFICATIONS.

Frequency Range-	85 to 8000 cps. Increased range possible with some sacrifice of response.
Frequency Response-	4 db over entire range. Flat amplifier characteristic over-all.
Analyzing Filter Bandwidths-	45 and 300 cps.
Recording Time-	Any selected 2.4-second interval of any audio signal within the frequency range.
Recording Medium-	Magnetic film around periphery of turntable.
Displays Available-	Permanent Graphs: Displays 'a' and 'b' (see Sect. 1-1) may be made either on separate sheets or on the same sheet. Display 'a' (Sonagram) shows frequency-vs-time-vs-amplitude characteristics and is linear with respect to frequency and time; display 'b' (Section) shows intensity-vs-frequency at any six consecutive times in recorded 2.4-second interval- plot is linear with respect to frequency and intensity (db). Intensity range, 35 db. Maximum separation between sections, 0.04 seconds. Up to 6 separate sections on one sheet, or a total of 60 separate sections on ten sheets of any recorded sample may be made. With Sectioner Micrometer, separation between sections can be as close as 0.008 second.

Display 'c' is produced when Amplitude Display Unit (Catalog No. 670-B) is used; average amplitude-vs-time is plotted. Amplitude scale is logarithmic over 24-db and 34-db ranges.

Time Required for Analysis: 5 minutes for display 'a', additional 5 minutes for display 'b', 1-1/4 minutes for display 'c'.

Aspect Ratio of Sonagram: 4 inches by 12 inches on 5-5/8 by 12-3/4 inch facsimile paper (for 4-inch drum).

Record-Reproduce Amplifier Characteristics- Flat or approximately 15-db high-frequency pre-emphasis for voice studies.

Microphone- Altec-Lansing 633A dynamic.

Input Impedance- 30 ohms

Power Supply- Input approximately 180 watts, 117 volts ($\pm$ 10%), 60 cps ac. (Available for 50-cps operation on special order). B+ electronically regulated.

SECTION II

INSTALLATION

2-1 INTRODUCTION.

The operating area for the Sona-Graph should be as free as possible from vibration, due to the presence of operating machinery or other sources of vibration. Extreme variations of ambient temperature should also be avoided. Observation of these precautions will result in the user receiving optimum performance from the equipment.

CAUTION Before attempting to operate the equipment, accomplish the unpacking and inspection procedure outlined in Section 1-5. To prevent damage during shipment the Record-Off-Reprod shift lever, turntable, and record and reproduce heads are fastened down, and must be freed.

2-2 CABLES (Interconnections between equipment).

The interconnecting cables between the several chassis are all in place when the Sona-Graph is shipped in console. It is only necessary to connect the a-c linecord (Cable #9) to a source of 117 volts ac, capable of delivering 180 watts. (See list of cables in Parts List, Sect. 7-1a).

a. Interconnection of chassis for rack mounting is accomplished as follows-

(1) Connect cable #1 from connector J-1 on the Amplifier-Analyzer to J-203 on the Recorder.

(2) Connect cable #2 from J-4 on the Amplifier-Analyzer to J-301 on the Power Supply.

(3) Connect cable #3 from J-3 on the Amplifier-Analyzer to J-204 on the Recorder.

(4) Connect cable #5 from J-2 on the Amplifier-Analyzer to J-205 on the Recorder.

(5) Connect cable #6 from J-10 on the Amplifier-Analyzer to J-207 on the Recorder.

(6) Connect cable #7 from J-5 on the Amplifier-Analyzer to J-206 on the Recorder.

(7) Connect cable #9 from J-302 on the Power Supply to the a-c power source.

b. Signal Input.

(1) For microphone input, connect the plug of the microphone cable into the Microphone receptacle on the Amplifier-Analyzer front panel.

(2) For tape-recorder input, connect a cable (not supplied) from the signal source to the Microphone receptacle. The connector of the cable should be wired for balanced input. If an unbalanced input source is used, connect a jumper between the ring and sleeve terminals of the input connector.

c. Signal Output.

If an external speaker is to be used, connect the speaker cable to the Ext. Speaker jack, located on the Amplifier-Analyzer panel.

SECTION III

IDENTIFICATION AND FUNCTION OF CONTROLS, INDICATORS, AND TERMINALS.

3-1 CONTROLS, Amplifier-Analyzer Unit.

CONTROL	POSITION	FUNCTION
Power ON-OFF Switch (S-5)	ON	This is a toggle-type switch located between the pilot light and the speaker grille, and controls a-c power input to the instrument. When this switch is set to the ON position, the power supply section is energized, furnishing filament voltage to all tubes and B+ to the circuitry.
	OFF	In the OFF position the instrumant is completely de-energized.
LINE-MIKE Switch (S-9)	MIKE	In MIKE position, the Amplifier-Analyzer input circuits are connected for use with a microphone having an output of -50 db and an impedance of 30 to 60 ohms.
	LINE	In LINE position, the Amplifier-Analyzer input circuits are connected for use with a 0-db, 600-ohm line.
REC - REP Switch (S-2)	REC	This switch selects the mode of operation of the record-reproduce amplifier. In REC position, the signal applied to the Microphone jack will be recorded on the turntable (when the Record-Off-Reprod lever is set to Record).
	REP	The recorded signal will be transferred from the turntable to the recording drum (when the Record-Off-Reprod lever is set to Reprod).
REC-REP LEVEL Pot. (R-138)	Variable	The gain of the record-reproduce amplifier may be adjusted by this control for both the record and reproduce functions.

3-1 CONTROLS, Amplifier-Analyzer Unit (continued).

CONTROL	POSITION	FUNCTION
FL-1 HS FL-2 Switch (S-1)	FL-1	This switch controls the response of the recording and reproducing system. When set to FL-1, the frequency response of the system is linear.
	HS	Pre-emphasis is added to the recording circuits in this position.
	FL-2	Pre-emphasis is provided during recording and further equalization is added during reproducing, resulting in a linear response.
MONITOR GAIN Pot. (R-139)	Variable	This control is used to adjust speaker volume.
FREQ SPREAD Switch (S-7)	85cps/4kc	This switch controls the range of the vertical scale of the graphic recording. When set to 85 cps/4 kc position, the scale is from 85 to 4000 cps.
	NORM	In this position the scale is from 85 to 8000 cps.
	4kc/8kc	The scale is from 4000 to 8000 cps in this position.
BAND SELECTOR Switch (S-3, part of)	NARROW	In Narrow position, the bandpass of the filter is approximately 45 cps.
	WIDE	In this position the bandpass is approximately 300 cps.
MARK LEVEL Pot. (R-140)	Variable	The gain of the marking amplifier, and therefore, the intensity of the graphic recording is adjusted with this control. (It also has an effect on the length of the 'section' line produced when preparing a section. To make a Section, see instructions in Sect. 4-1e.
SECTIONER Switch (S-4)	ON	When preparing a section, this switch is set to ON, thereby disabling the agc circuit, and activating the sectioner circuits.

3-1 CONTROLS, Amplifier-Analyzer Unit (continued).

	OFF	When making a normal graphic recording, this switch is set to OFF, activating the agc circuits to compress the dynamic range of the applied signal within the 6-db range of the recording paper.
INVERT BURN-FREQ NORMAL Switch (S-8)	INVERT BURN	This switch is used to invert the frequency scale of the graphic recording. In application, a normal graph can be recorded on the lower half of the record and a section on the upper half. This switch should be set to Invert Burn when the lower half of the graphic record is complete, to reverse the frequency scale of the sectioned half. This produces a corresponding frequency scale for the two halves of the record.
	FREQ NORMAL	This position is used to produce a normal recording.
SMALL DRUM-LARGE DRUM Switch (S-10)	Small Drum	This position is used when the 4-inch drum is in place.
	Large Drum	When the 12-inch drum is used S-10 should be in Large Drum position. NOTE- This switch controls the plate potential for power amplifier tube V-16. When set to Small Drum position, the potential is 250 volts, when set to Large Drum position, the potential is increased to 350 volts to provide the necessary output power to mark the paper used with the large drum. CAUTION- It is important that this switch be appropriately set to avoid overburning, and overloading the power amplifier.
MICROPHONE Jack (J-6)	---	This is the signal input jack of the Sona-Graph.
EXT SPEAKER Jack (J-7)	---	An external speaker may be plugged into this jack.
VU METER (M-1)	---	An indication of the recording and reproducing level at the output of the record-reproduce amplifier is provided by this meter.

3-2 CONTROLS, Recorder Unit.

CONTROL	POSITION	FUNCTION
RECORD-OFF-REPROD LEVER		This lever controls the application of power to the turntable and blower motor, engages the two-speed drive mechanism, and activates the control circuits for the recorder.
	Record	When set to Record, the turntable is operated at 24 rpm.
	Reproduce	In this position turntable rpm is 80.
	Off	In Off position, all components are de-energized.
Alarm Buzzer DS202	---	The alarm buzzer provides an audible signal when the ON-OFF switch of the amplifier-analyzer is set to Off while the two-speed drive mechanism is engaged. The Record-Off-Reprod lever should be set to Off (neutral) to prevent flat spots from developing on the rubber drive wheels.
Stylus Control Lever	Variable	This lever engages the stylus assembly with the leadscrew for preparing charts. A detent at the bottom of the leadscrew locks the stylus away from the drum to facilitate drum changing and installation, and removal of chart paper.
Sectioner Micrometer Plate	---	The index (provided only on the small drum) is used to divide the time of the recorded chart into 300 units for preparing sections. Sixty holes positioned around the top of the plate provide for actuator pin placement, while a vernier on the plate provides five intermediate settings.
Sectioner Microswitch (S-203)	---	This switch is located at the top of the stylus housing and functions when sections are made. The switch is operated each time a pin in the sectioner micrometer plate hits the actuating arm. A half-round pin, with knurled knob, is provided to disengage the microswitch when preparing a normal graph.

SECTION IV

OPERATION

4-1 GENERAL OPERATING INSTRUCTIONS.

NOTE- Before attempting to operate the equipment, the unlocking operations outlined in Section 1-5 must be accomplished.

a. Initial Setting of Controls.

Operation of the Sona-Graph involves at least two operations: (1) making a magnetic recording of the signal to be analyzed, and (2) producing a graphic recording. Prior to operation or checkout of the equipment, set the controls to the positions indicated below; controls not listed may be left in any position.

CONTROL	POSITION
Amplifier-Analyzer	
ON-OFF Switch	OFF
REC-REP Switch	REC
REC-REP LEVEL Control	Fully counterclockwise
MONITOR GAIN Control	Fully counterclockwise
MARK LEVEL Control	Fully counterclockwise
SECTIONER Switch	OFF
INVERT BURN-FREQ NORMAL Switch	FREQ NORMAL
Recorder	
RECORD-OFF-REPROD	OFF
Stylus Control Lever	On detent at bottom of leadscrew
Microswitch Actuating Knob	To engage microswitch

GENERAL. -Due to the many variations of the basic chart types, a summary of the charts with the pertinent characteristics and operating switch positions is given below. The summary may be used as a guide to speed equipment operation after the operator is familiar with the analyzer.

CHART			SWITCH POSITIONS		
Type	Bottom Freq	Top Freq	SECTIONER	INVERT BURN-FREQ NORM L	FREQ SPREAD
Spectrogram	85	4000	OFF	FREQ NORMAL	85cps/4kc
Spectrogram	85	8000	OFF	FREQ NORMAL	NORM
Spectrogram	4000	85	OFF	INVERT BURN	85cps/4kc
Spectrogram	8000	85	OFF	INVERT BURN	NORM
Spectrogram	4000	8000	OFF	FREQ NORMAL	4kc/8kc
Spectrogram	8000	4000	OFF	INVERT BURN	4kc/8kc
Section	85	4000	ON	INVERT BURN	85cps/4kc
Section	85	8000	ON	INVERT BURN	NORM
Section	4000	85	ON	FREQ NORMAL	85cps/4kc
Section	8000	85	ON	FREQ NORMAL	NORM
Section	4000	8000	ON	INVERT BURN	4kc/8kc
Section	8000	4000	ON	FREQ NORMAL	4kc/8kc
Combination I					
(Spectrogram)	85	4000	OFF	FREQ NORMAL	NORM
(Section)	4000	85	ON	FREQ NORMAL	NORM
Combination II					
(Spectrogram)	85	4000	OFF	FREQ NORMAL	NORM
(Section)	85	4000	ON	INVERT BURN	NORM

b. Recording. - The audio signal to be recorded must meet the following criteria: the signal must be within the frequency range of 85 to 8000 cps, must occur within a 2.4-second interval, and must be of sufficient amplitude when supplied from other equipment (0 VU level across a 600-ohm balanced or unbalanced line). Prepare a magnetic recording as follows:

(1) Set the controls of the analyzer to the positions listed in paragraph a.

(2) Connect the input signal to Microphone jack, and set Line-Mike switch to the position corresponding to the input source.

(3) Set FL-1-HS-FL-2 switch to the desired shaping position. In general, positions FL-1 and FL-2 are recommended for tone or pulse signals, while HS is recommended for voice signals. However, voice signals may be recorded in any shaping position.

(4) Set REC-REP switch to REC, and ON-OFF switch to ON. The pilot lamp should glow, indicating the application of power. Allow the amplifier-analyzer and power supply to warm up for about 10 minutes.

(5) Set RECORD-OFF-REPROD lever of the recorder to RECORD. The turntable should rotate, the blower should operate, and a click should be heard, indicating the operation of the control relay.

(6) Rotate REC-REP LEVEL control until the VU meter indicates approximately -15 VU for a square-wave signal, or between -3 and +1 VU for the peaks of a speech signal. At this time, the input signal is being recorded on the magnetic turntable as it passes the recording head, and erased as it passes the erase head. Therefore, only the 2.4-second portion of the signal immediately preceeding the erase head is present on the turntable.

(7) Set REC-REP switch to REP to stop the recording process, and to monitor what has been recorded on the turntable. Adjust MONITOR GAIN control as required. If the sample recording is not satisfactory, record a new sample by repeating steps (6) and (7).

(8) After a satisfactory recording has been obtained, set REC-REP switch to REP, and RECORD-OFF-REPROD lever of the recorder to OFF.

c. Recording Paper Installation.

Before preparing a chart of the recorded signal, recording paper must be installed. The procedure is given below.

(1) Slide RECORD-OFF-REPROD lever toward RECORD until a click is heard, indicating that the control relay is energized. Do not move the lever beyond this point; the turntable should not rotate.
Set MONITOR GAIN and REC-REP LEVEL controls to provide a convenient listening level. Manually rotate the drum (using the knurled knob) until a click is heard over the speaker, indicating the end of the recorded signal.

(2) Note the index number on the drum where the stylus would normally contact the recording paper (use the stylus control lever to move the stylus toward the drum).

(3) Manually rotate the drum until the index point, from step (2), is away from the stylus assembly.

(4) Wrap the recording paper, in a counterclockwise direction around the drum, with the outside end of the paper aligned with the index point from step (2). Gently align the paper so that it rests on the bottom flange of the drum, and secure it with two rolling springs at the top and bottom of the drum.

NOTE- Care should be exercised to ensure proper paper installation. Improper installation will cause the stylus to lift and tear the edge of the recording paper.
Be sure the amplifier-analyzer has been operating for a few minutes to stabilize the oscillator circuits.

d. Making a Spectrogram.

(1) Prepare a recording in accordance with step b.

(2) Install recording paper in accordance with step c.

(3) Set the analyzer controls to the positions indicated in a, corresponding to the type of spectrogram desired.

(4) Set REC-REP switch to REP, and BAND SELECTOR switch to WIDE or NARROW, according to the resolution desired; set FL-1-HS-FL-2 switch to the same position used during recording; and set LARGE DRUM-SMALL DRUM switch to the position corresponding to the size drum used.

(5) Set RECORD-OFF-REPROD lever of the recorder to REPROD. The turntable should rotate.

(6) Adjust REC-REP-LEVEL control to abtain an indication of about -15 VU on the VU meter for pulse signals, or approximately 0 VU for the peaks of voice signals.

(7) Adjust MARK LEVEL control until the stylus voltage is sufficient to mark the recording paper without overburning. Overburning causes poor definition and stylus deterioration.

NOTE- Do not allow the stylus to touch the recording paper when adjusting MARK LEVEL control unless drum is rotating.

(8) Lift and move the stylus control handle to bring the stylus into contact with the recording paper. The stylus is simultaneously engaged with the leadscrew.

(9) The stylus will automatically travel from the bottom to the top of the drum to produce the spectrogram.

(10) When the spectrogram is completed, return the stylus to its rest position at the bottom of the leadscrew, set RECORD-OFF-REPROD lever of the recorder to OFF, and remove the recording paper. Observe and record the index number at the end of the recording paper for future reference.

NOTE- For the first and the last few revolutions of the turntable, no burning occurs. This assures a proper frequency range across the recording paper.

e. Making a Section. ··

A section can only be produced on the small drum, and at any preselected point on the time scale of the recording. Several sections may be made simultaneously, provided that they are more than 0.4 second apart (approximately 60° of drum rotation), unless their levels are sufficiently low to prevent overlapping. Prepare a section as follows:

(1) Prepare a spectrogram in accordance with step d. Do not remove the recording paper after the spectrogram is completed.

(2) Determine the points at which the sections are to be taken. If the desired points are closer than 0.4 second, more than one section chart is required.

(3) Manually rotate the drum (using the knurled knob) until the stylus is in line with the point at which the section is to be taken. Place the stylus against paper to precisely determine starting point.

(4) Release the section microswitch by rotating the microswitch control knob one-half turn.

(5) Insert one of the knurled pins, stored in the top of the drum, into one of the sixty holes in the drum index which will contact the actuating arm of the microswitch at this position. Place other knurled pins in the holes at the top of the drum where other sections are to be taken.

(6) Manually rotate the drum, using the knurled screw, and check to see that the microswitch is actuated as each pin passes the actuating arm (an audible click occurs as the microswitch is actuated).

(7) For future reference, mark the points on the spectrogram where sections are to be taken.

(8) Note the index position of the recording paper of the spectrogram and remove the recording paper.

(9) Install a new piece of recording paper in accordance with step c and align it with the index position noted in step (8).

(10) Set the amplifier-analyzer controls to the positions indicated in a, corresponding to the section range desired.

(11) Set LARGE DRUM-SMALL DRUM switch to SMALL DRUM and the REC-REP-LEVEL and MARK LEVEL controls to the positions required for marking.

(12) Set RECORD-OFF-REPROD lever of the recorder to REPROD and engage the stylus.

(13) The stylus will automatically travel from the bottom to the top of the drum to produce the section.

(14) When the section is completed, return the stylus to its rest position at the bottom of the leadscrew, set RECORD-OFF-REPROD lever of the recorder to OFF, and remove the recording paper.

(15) Place the paper with the section directly above the paper with the spectrogram, and align the base lines of the sections

with the points marked on the spectrogram.

NOTE- When analyzing the signal amplitudes, 5 db of signal amplitude is represented by 5 millimeters of denoted amplitude on the recording paper; the relative signal amplitudes may be compared.

f. Making a Combination Chart.

A combination chart consists of a chart on which the lower half is in the form of a spectrogram, and the upper half is in the form of a section. After selecting the type of chart, in accordance with a, set the indicated switches to the required positions, and proceed in the same manner as that for preparing a spectrogram. When the spectrogram is half finished, set SECTIONER switch to ON, and INVERT BURN-FREQ NORMAL switch as required. Do not touch other analyzer controls. After the chart is completed, stop the analyzer and remove the completed chart.

NOTE- Knurled pins for sectioner operation must be installed, and the microswitch released, before starting.

SECTION V

THEORY OF OPERATION

5-1 BASIC SYSTEM PRINCIPLES.

The analyzer is designed to record a signal on a magnetic strip, and transform the recorded signal into a graphical presentation by selectively scanning the signal for its amplitude and frequency components, and recording this information on a chart. Thus, two modes of operation are provided for the analyzer; one for use during recording and the other for use during reproducing. The amplifier-analyzer, recorder, and power supply, and the major components of the analyzer, provide all of the equipment required for operation. A brief description of the three components is given below to acquaint the reader with their function.

a. Recorder

The recorder is a synchronous-motor-driven, 12-inch turntable with a sensitive magnetic strip around the edge, which rotates at either 24 or 80 rpm. Positioned around the rim of the turntable are two magnetic recording heads; one for use as a record-reproduce head and the other as an erase head. A column, containing the components required for reproducing, is located on the top of the recorder, and contains a stylus assembly, a turntable-driven leadscrew, and a variable resistor. A blower and filter are positioned below the recorder for removing smoke generated during reproducing. A control relay and the other parts required for operation are located on the underside of the recorder.

b. Power Supply

The power supply distributes 117-volts a-c power to the recorder, and develops the d-c power required for the amplifier-analyzer.

c. Amplifier-Analyzer

The amplifier-analyzer contains seven major circuits used during recording and reproducing. These include a record-reproduce amplifier, a modulator, a three-stage marking amplifier with a power amplifier, a monitor amplifier, an AGC circuit, a sectioner circuit, and a variable-frequency oscillator. Various groupings of the seven circuits are used during the record and reproduce modes of operation.

5-2 BLOCK-DIAGRAM DISCUSSION- RECORD MODE.

Figure 5-1 shows the analyzer as used during the record mode of operation. An input signal, from either a 30- to 60-ohm microphone with an output level of -50 db or a 500/600-ohm line with an output level of 0 db, is connected to MICROPHONE jack J6, and fed to the input network. The input network selects the attenuation appropriate to the signal source, and routes the signal through REC-REP switch S2 to the input of record-reproduce amplifier tube V1. The signal is amplified at record-reproduce amplifier tube V1, and routed to record-reproduce amplifier tubes V2 and V3 for further amplification. A low-level output from record-reproduce amplifier tube V3 is routed to monitor amplifier tube V4; and high-level outputs are routed to VU meter M1 and record-reproduce head PU201. The signal routed to monitor amplifier tube V4 is amplified to drive an internal loudspeaker, or, alternatively, an external speaker connected to EXT SPEAKER jack J7. The signal routed to record-reproduce head PU201 is combined with a signal from bias-erase oscillator tube V5. Bias-erase oscillator tube V5 provides the driving signal from erase head PU202, and supplies the bias signal required by record-reproduce head PU201. Amplifier tubes V1 through V4 are energized in all modes of operation, while oscillator tube V5 is energized only during recording.

The power supply circuits generate and regulate the power required for the amplifier-analyzer. Rectifier tube V301, in conjunction with a voltage regulator consisting of tubes V302 through V305 and V306B, develops supplies of +450 and +250 volts dc; rectifier tube V306A and regulator tube V307 develop a supply of -120 volts dc.

5-3 BLOCK-DIAGRAM DISCUSSION- REPRODUCE MODE.

Figure 5-2 shows the analyzer as it is used during the reproduce mode. The signal recorded on the magnetic drum is picked up by record-reproduce head PU201 and applied to the input of the record-reproduce amplifier through the contacts of REC-REP switch (S2, amplifier-analyzer). The operation of record-reproduce amplifier tubes V1, V2, and V3 is essentially the same as in the record mode, except that the output of record-reproduce amplifier is connected to the modulator, and equalization occurs between record-reproduce amplifier tubes V1 and V2. The modulator is also supplied with a signal from variable oscillator tube V6 and amplifier tube V7. The operation of the variable oscillator is controlled by control resistor R201 and the variable oscillator control circuits. The moving tap on control resistor R201 is moved in conjunction with the stylus assembly on the drum.

The modulator combines the audio and variable-oscillator signals and selects difference frequency components at 35 kc. (Note that the recording is played back at approximately 3-1/3 times the recording speed, thus increasing the audio signal frequency from a range of 85 to 8000 cps to a range of 283 to 26,664 cps; the oscillator frequency varies from 35 kc to

61.6 kc). The 35-kc output signal is routed to the input of 35-kc amplifier tube V10. The output of 35-kc amplifier tube V10 is fed directly to pre-amplifier tube V11 where it is further amplified and then fed to marker amplifier tube V12. After amplification, the signal is routed to power amplifier tube V16 through the contacts of SECTIONER switch S4. The output of the power amplifier is then used to drive the marking stylus for preparing a chart.

The analyzer circuit is modified during reproduction to include the AGC circuit when a normal display (frequency and intensity vs time) is being prepared, or to exclude the AGC circuit when a section is being prepared. The AGC circuit is used to compress the dynamic range of the signal into the dynamic range of the recording paper (the signal range is approximately 35 db; the paper range is 6 db). A sample of the signal is selected at 35-kc amplifier tube V10 and applied to AGC-amplifier tube V17, where it is amplified. The signal is then further amplified by AGC-amplifier tube V18, and then rectified by AGC-rectifier tube V19. The resultant d-c signal is fed to marker-amplifier tube V12, where it is used to control the gain of the marking-amplifier circuits.

When preparing a section, the AGC circuits are disconnected from marking-amplifier tube V12, and the output of pre-amplifier tube V11 is fed to trigger-pulse amplifier tube V13 instead of to power-amplifier tube V16 (the input of amplifier tube V16 is connected to the output of the sectioner circuits). The trigger-pulse amplifier generates a pulse whose duration is a direct function of the amplitude of the signal at an instant of time determined by the location of contact pins at the top of the drum. The trigger pulse is amplified by dc-amplifier tube V14 and routed to sectioner multivibrator tube V15. The trigger pulse is used to enable the multivibrator (normally biased at cut-off), to sustain oscillations for the duration of the pulse. The output of sectioner multivibrator tube V15 is fed to power-amplifier tube V16 where it is used to generate a line on the graph directly proportional to the signal amplitude (5 mm = 5 db).

It should be noted that the AGC, marker, variable oscillator, and sectioner circuits are de-energized during the record mode of analyzer operation.

5-4 DETAILED THEORY OF OPERATION.

The following paragraphs describe each of the circuits considered in the block-diagram discussions. The proper schematic at the rear of the manual should be referred to during the discussion.

a. Input Network

An input network, consisting of resistors R135 through R137,

transformer T2, and LINE-MIKE switch S9, is connected between MICROPHONE jack J6 and the input of record-reproduce amplifier tube V1. The network provides a means of matching the signal from either a microphone or a line signal source to the input of the record-reproduce amplifiers. When LINE-MIKE switch S9 is set to MIKE, the input from the microphone (at approximately -50 db), is connected directly to the primary windings of transformer T2; when set to LINE, approximately 50 db of attenuation is connected between MICROPHONE jack J6 and the primary windings of transformer T2. The output of transformer T2 is connected to the input of record-reproduce amplifier tube V1.

b. Record-Reproduce Amplifier Tube, V1.

Record-reproduce amplifier tube V1 is a typical pentode voltage amplifier having two modes of operation. When REC-REP switch S-2 is set to REC, the input circuit is connected to the input signal from the input network, and the output circuit is connected to the record equalization filter. When REC-REP switch S2 is set to REP, the input circuit is connected to record-reproduce head PU201 and the output is connected to the reproduce equalization filter. The two filters are selected to compensate for the non-linear characteristics of the recording medium and the record-reproduce head.

c. Record-Reproduce Amplifier Tube, V2.

Record-reproduce amplifier tube V2 is a typical triode amplifier which is resistance-capacitance coupled to the output from record-reproduce amplifier tube V1. Two sets of filters are connected to the cathode and output circuits of the amplifier. When REC-REP switch S2 is set to REC, the cathode circuit is connected to a shaping network at FL-1-HS-FL-2 switch S1, and the output circuit uses no filtering. When REC-REP switch S2 is set to REP, the cathode circuit is connected to an equalization filter to compensate for the change in re-production speed as compared to the record speed; the output circuit is connected to a loading resistor and to the shaping network. The shaping network provides variation in the frequency response characteristics of the record-reproduce amplifiers. When the shaping network is set to FL-1, the amplifier response during both recording and reproducing is essentially linear; when set to HS, the response of the amplifier is altered during both recording and reproducing to provide a response curve which increases with frequency, to emphasize the normally weaker, high-frequency components of speech; and, when set to FL-2, provides an increasing response toward the higher frequencies during recording, and matching equalization during reproduction, resulting in an over-all flat response.

d. Record-Reproduce Amplifier Tube, V3.

Record-reproduce amplifier tube V3 consists of a two-stage, dual-triode, voltage amplifier. The operation of each stage is discussed.

(1) The first stage of record-reproduce amplifier tube V3 is a conventional triode amplifier whose input is resistance-capacitance coupled to the output of record-reproduce amplifier tube V2. REC-REP LEVEL control R138, a step attenuator, is connected in the input circuit to provide control of the amplifier gain. The cathode circuit of the stage is connected to REC-REP switch S2 which provides a higher amplifier gain during reproduce, or is connected to the shaping network during record. The output of the stage is resistance-capacitance coupled to the second stage of record-reproduce amplifier tube V3, and to the input of monitor amplifier tube V4.

(2) The second stage of record-reproduce amplifier tube V3 is also a conventional triode amplifier with several outputs. A description of each termination follows:

(a) A 75-kc filter trap to bypass feedback from bias-erase oscillator tube V5 during recording.

(b) A 35-kc filter trap to bypass feedback from modulator during reproducing.

(c) VU meter M1 circuits to permit monitoring of the recording and reproducing signals.

(d) Test jack TP10 to permit measurement of the amplifier response during testing.

(e) An audio signal output to modulator diodes CR1 through CR4.

(f) An audio signal output to record-reproduce head PU201.

e. Monitor Amplifier Tube V4.

Monitor amplifier tube V4 permits monitoring of the recording or reproducing signal by means of an internal or external loudspeaker. The amplifier is a conventional push-pull amplifier using a dual triode. Adjustment of the speaker volume is provided by MONITOR GAIN control R139 at the input circuit of the amplifier. The output of the amplifier is coupled to the speaker through wind-

ings of transformer T5 and EXT SPEAKER jack J7. EXT SPEAKER jack J7 is of the shorting type, and opens the circuit to the internal speaker when an external speaker is connected.

f. Bias-Erase Oscillator Tube, V5.

Bias-erase oscillator tube V5 is a multivibrator oscillator which operates at approximately 75 kc. The oscillator output is used to drive erase head PU202 to clear the magnetic strip prior to recording, and to provide a bias signal to improve the recording characteristics. The bias signal is coupled to record-reproduce head PU201 through a pair of capacitors which provide adjustment of the bias current. The plate circuit of bias-erase oscillator tube V5 is connected to the plate supply through the contacts of control relay K201, switch S6, and REC-REP switch S2. Therefore, the bias-erase oscillator is energized only during the record mode of operation. Switch S6 permits measurement of the recording signal current through the record-reproduce head without the presence of the bias signal.

g. Variable Oscillator Control Circuits.

The variable oscillator control circuits control the range of sweep of variable oscillator tube V6 during reproduction. A d-c voltage is divided by a series combination of four resistors, one of which is control resistor R201. Resistor R201 is adjusted in accordance with the stylus motion on the drum, thus varying the potential of the voltage. The output voltage is then used to control the frequency of variable oscillator tube V6. FREQ SPREAD switch S7 selects one of the three resistor combinations to provide various potential ranges across the control resistor, which in turn, provides different frequency ranges of variable oscillator tube V6. SECTIONER switch S4 provides a polarity reversal of the voltage at control resistor R201 to reverse the frequency range of the variable oscillator tube. The use of the sectioner permits the recording of a combination chart with one-half in the form of a spectrogram, and the other half in the form of a section with a reversed frequency scale. If a common frequency scale is desired, INVERT BURN-FREQ NORMAL switch S8 provides a second reversal of the frequency scale.

h. Variable Oscillator Tube, V6.

Variable oscillator tube V6 generates a signal whose frequency varies directly with the motion of the stylus in accordance with a control signal from the variable oscillator control circuits. The variable oscillator is a dual triode connected as a multivibrator oscillator, with the output frequency controlled by the bias vol-

tage. In accordance with the variable oscillator control circuits, the frequency will vary from 35 kc to 48.2 kc when FREQ SPREAD switch S7 is set to 85 cps/4 kc, from 35 kc to 61.6 kc when set to NORM, or 48.2 kc to 61.6 kc when set to 4 kc/8 kc.

i. Amplifier Tube, V7.

Amplifier tube V7 is a conventional triode amplifier, connected to the output of variable oscillator tube V6, to isolate the oscillator from the loading effects of the output circuits. The output is coupled to transformer T1, where it is routed to the modulator.

j. Modulator.

The modulator consists of diodes CR1 through CR4 and resistor R141 arranged as a balanced modulator. The modulator receives an audio signal from record-reproduce amplifier tube V3, and a variable frequency signal from amplifier tube V7. The output of the modulator is connected to a filter so that an output signal will be obtained only when the frequency difference between the two signals is approximately 35 kc. The output from the filter is routed to 35-kc amplifier tube V10. Resistor R141 and capacitor C78 are used to balance the modulator to prevent spurious response.

k. 35-KC Amplifier Tube, V10.

The 35-kc amplifier tube V10 consists of a tuned pentode amplifier and a two-position bandpass filter. The input 35-kc signal from the modulator is amplified and fed to bandpass filter Z1 in the output circuit. The output of the bandpass filter is routed to preamplifier tube V11. BAND SELECTOR switch S3 is connected to various points of the bandpass filter to change the characteristics of the filter; when set to WIDE, the effective bandpass (3 db points) is approximately 300 cps; and when set to NARROW, it is approximately 45 cps. This permits only those components of the signal which are within the bandpass range of the filter to be routed to the pre-amplifier tube. The filter has an attenuation characteristic that provides an output signal of 0.15 volt for an input signal of 3.0 volts. Two special outputs are selected by BAND SELECTOR switch S3 for routing to AGC amplifier tube V17: when set to WIDE, the output is taken at the input to 35-kc amplifier tube V10; and when set to NARROW, the output is taken at the bandpass filter. REC-REP switch S2, in the plate supply circuit of this stage, provides plate supply power only when set to REP (the reproduce mode of analyzer operation).

l. Pre-Amplifier Tube, V11.

Pre-amplifier tube V11 is a conventional pentode amplifier provided to restore the signal level attenuated by the bandpass filter of 35-kc amplifier tube V10. The input signal is coupled directly to the input of the pre-amplifier from the bandpass filter. The output of the pre-amplifier is resistance-capacitance coupled to the input of marker amplifier tube V12. REC-REP switch S2, in the plate supply circuit of this stage, provides plate supply power only when set to REP (the reproduce mode of analyzer operation).

m. Marker Amplifier Tube, V12.

Marker amplifier tube V12 is a pentode amplifier operated with grounded cathode, and grid bias from one of two sources, depending upon the type of chart being prepared. When a spectrogram is being prepared (SECTIONER switch S4 set to OFF), the bias for the amplifier is routed from AGC rectifier tube V19; when a section is being prepared (SECTIONER switch S4 set to ON), the bias for the amplifier is supplied from a voltage divider connected to the -120 volt d-c supply. The output of marker amplifier tube V12 is routed to power amplifier tube V16 when SECTIONER switch S4 is set to OFF, and to trigger pulse amplifier tube V13, when set to ON. Switch S204, electrically connected in the screen-grid circuit of the amplifier and physically located on the stylus housing, disables the amplifier by shorting the screen grid to ground. The shorted screen grid prevents the amplifier from operating when the stylus has reached either the top or bottom limit of the chart during marking. MARK LEVEL control R140 provides a signal level adjustment to control the darkness of the chart being produced. REC-REP switch S2, in the plate supply circuit of this stage, provides plate voltage only when set to REP (the reproduce mode of analyzer operation).

n. Power Amplifier Tube, V16.

Power amplifier tube V16 provides a 35-kc signal for driving the recording stylus. When preparing a spectrogram, the input to the power amplifier is routed from marker amplifier tube V12; when producing a section, the input is routed from sectioner multivibrator tube V15. Both of the input signals are at 35 kc, and a tuned circuit is provided in the grid circuit to eliminate spurious signals. The power amplifier uses a beam-power tube, and couples the output signal to the stylus through transformer T4. LARGE DRUM - SMALL DRUM switch S10 is provided in the plate circuit to change the plate supply voltage from 250 to 350 volts dc.

The increased plate supply voltage is required to obtain increased stylus power when the large drum is used for chart preparation. REC-REP switch S2, in the plate circuit of the power amplifier, provides plate power only when set to REP (the reproduce mode of analyzer operation), provided LARGE DRUM - SMALL DRUM switch S10 is set to SMALL DRUM. The 350-volt supply is directly connected when LARGE DRUM - SMALL DRUM switch S10 is set to LARGE DRUM.

o. AGC Amplifier Tube, V17.

AGC amplifier tube V17 consists of a dual-triode, two-stage, resistance-capacitance coupled amplifier which amplifies the input signal routed from 35-kc amplifier tube V10. The output of AGC amplifier tube V17 is resistance-capacitance coupled to AGC amplifier tube V18.

p. AGC Amplifier Tube, V18.

AGC amplifier tube V18 is a pentode amplifier operated with a grounded cathode, and bias routed from AGC rectifier tube V19. As the signal amplitude is increased, the bias signal is increased, thus reducing the gain of this stage. The effect of the feedback from AGC rectifier tube V19 is to reduce the dynamic range of the recorded signal to approximately 6 db. The output of AGC amplifier tube V18 is routed to AGC rectifier tube V19.

q. AGC Rectifier Tube, V19.

AGC rectifier tube V19 is a double-diode rectifier operated as a half-wave diode rectifier, and as a clipper diode to limit the inverse voltage across the other diode. The input signal routed from AGC amplifier tube V18 is rectified and a portion is returned to the amplifier as a bias source. The output of the rectifier is routed to marker amplifier tube V12 for controlling the dynamic range of the signal being reproduced.

r. Trigger Pulse Amplifier Tube, V13.

Trigger pulse amplifier tube V13 samples the energy of the signal at marker amplifier tube V12, and, in conjunction with dc amplifier tube V14, generates a square-wave pulse whose width is directly proportional to the amplitude of the signal. The sampling signal is rectified and applied to capacitor C201. When the sectioner microswitch S203 is tripped by the pins on the drum, the energy stored in the capacitor is applied to an intergrating circuit at the input of the trigger pulse amplifier. The dual triode conducts while the capacitor in the integrating circuit discharges to the point where the stage is cut off, thus terminating the pulse in the output circuit. The pulse thus gen-

erated is directly coupled to dc amplifier tube V14. REC-REP switch S2, in the plate supply circuit of this stage, supplies plate power only when set to REP (the reproduce mode of analyzer operation).

s. DC Amplifier Tube, V14.

Dc amplifier tube V14 amplifies the pulse signal from trigger pulse amplifier tube V13. The amplifier, a dual-triode tube, generates an enabling pulse, which is fed to sectioner multivibrator tube V15, for controlling the on-time of the multivibrator. REC-REP switch S2, in the plate supply circuit of this stage, supplies plate power only when set to REP (the reproduce mode of analyzer operation).

t. Sectioner Multivibrator Tube, V15.

Sectioner multivibrator tube V15 employs a dual triode as a multivibrator oscillator, operating at 35 kc, and normally biased to cutoff. Cut-off bias is controlled by dc amplifier tube V14, which controls the on-time of the multivibrator with an enabling pulse. The 35-kc output signal is routed to power amplifier tube V16 for preparing a section chart. The reproduction of the pulse, which is proportional to the signal amplitude, is in the form of a line whose length indicates the signal amplitude (5db = 5mm). REC-REP switch S2, in the plate supply circuit, applies plate power only when set to REP (the reproduce mode of analyzer operation).

u. Rectifier Tube, V301.

Rectifier tube V301 is a full-wave double-diode rectifier which rectifies the high-voltage a-c power developed by transformer T301. The output of the rectifier is routed to a pi-type, inductance-capacitance filter to eliminate ripple in the output voltage. The output is coupled to a voltage regulator consisting of tubes V302 through V305 and V306B.

v. Voltage Regulator Tubes, V302 thru V305, and V306B.

The voltage regulator controls the output voltage of rectifier tube V301, and supplies a constant-voltage output of +250 volts dc. Amplifier tubes V304 and V306B sample the output voltage and compare it with the voltage across reference tube V305. The difference voltage is used to control the conduction of regulator tubes V302 and V303, and thus to regulate the output voltage.

w. Rectifier Tube, V306A.

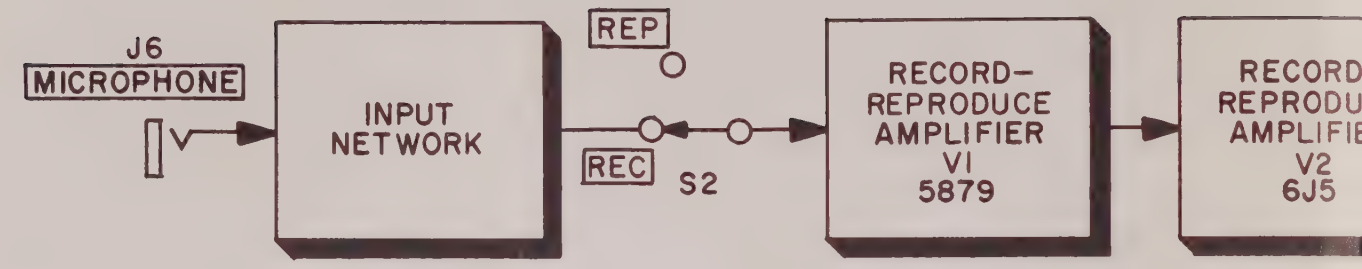
Rectifier tube V306A is a triode, connected as a diode, to rectify the voltage produced by transformer T303. The cathode of the rectifier is routed to ground through regulator tube V307. The anode side of the rectifier supply, at the high side of the transformer, is applied to a resistance-capacitance filter and routed to the amplifier-analyzer.

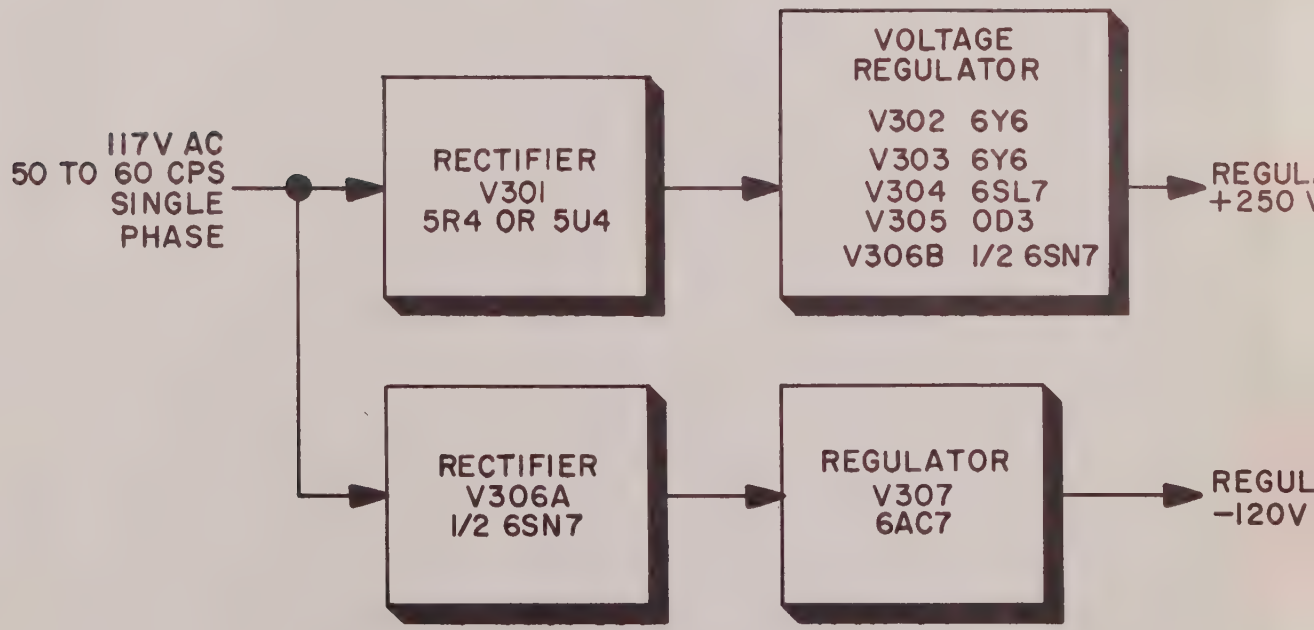
x. Regulator Tube, V307.

Regulator tube V307 samples the output voltage of the -120 volt supply, and compares it to the output of the +250 volt supply. The error voltage thus produced controls the conduction of the regulator and thus the output voltage of the supply.

y. Recorder Alarm Circuit.

The recorder alarm circuit provides an audible signal when the analyzer is turned off, and the RECORD-OFF-REPROD lever of the recorder is set to either REPROD or RECORD. The alarm circuit prevents accidental development of flat spots on the rubber drive wheels. The buzzer will cease operating when either power is again turned on, the RECORD-OFF-REPROD lever is set to OFF, or both.


J6
MICROPHONE
INPUT
NETWORK
REP
REC
S2
RECORD–
REPRODUCE
AMPLIFIER
V1
5879
RECORD
REPRODU
AMPLIFIE
V2
6J5


117V AC
50 TO 60 CPS
SINGLE
PHASE
RECTIFIER
V301
5R4 OR 5U4
VOLTAGE
REGULATOR
V302 6Y6
V303 6Y6
V304 6SL7
V305 0D3
V306B 1/2 6SN7
REGUL
+250 V
RECTIFIER
V306A
1/2 6SN7
REGULATOR
V307
6AC7
REGUL
–120V

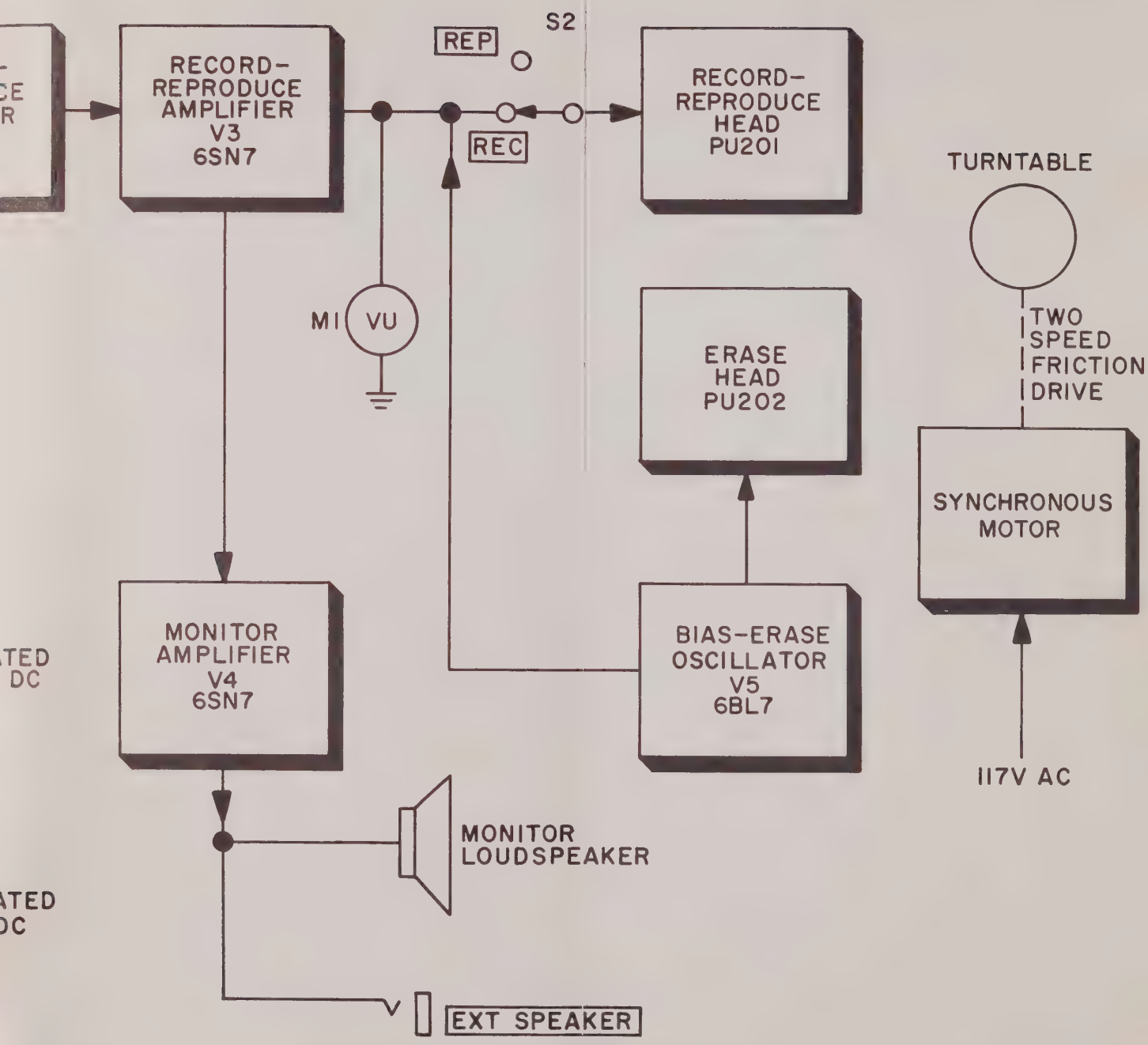
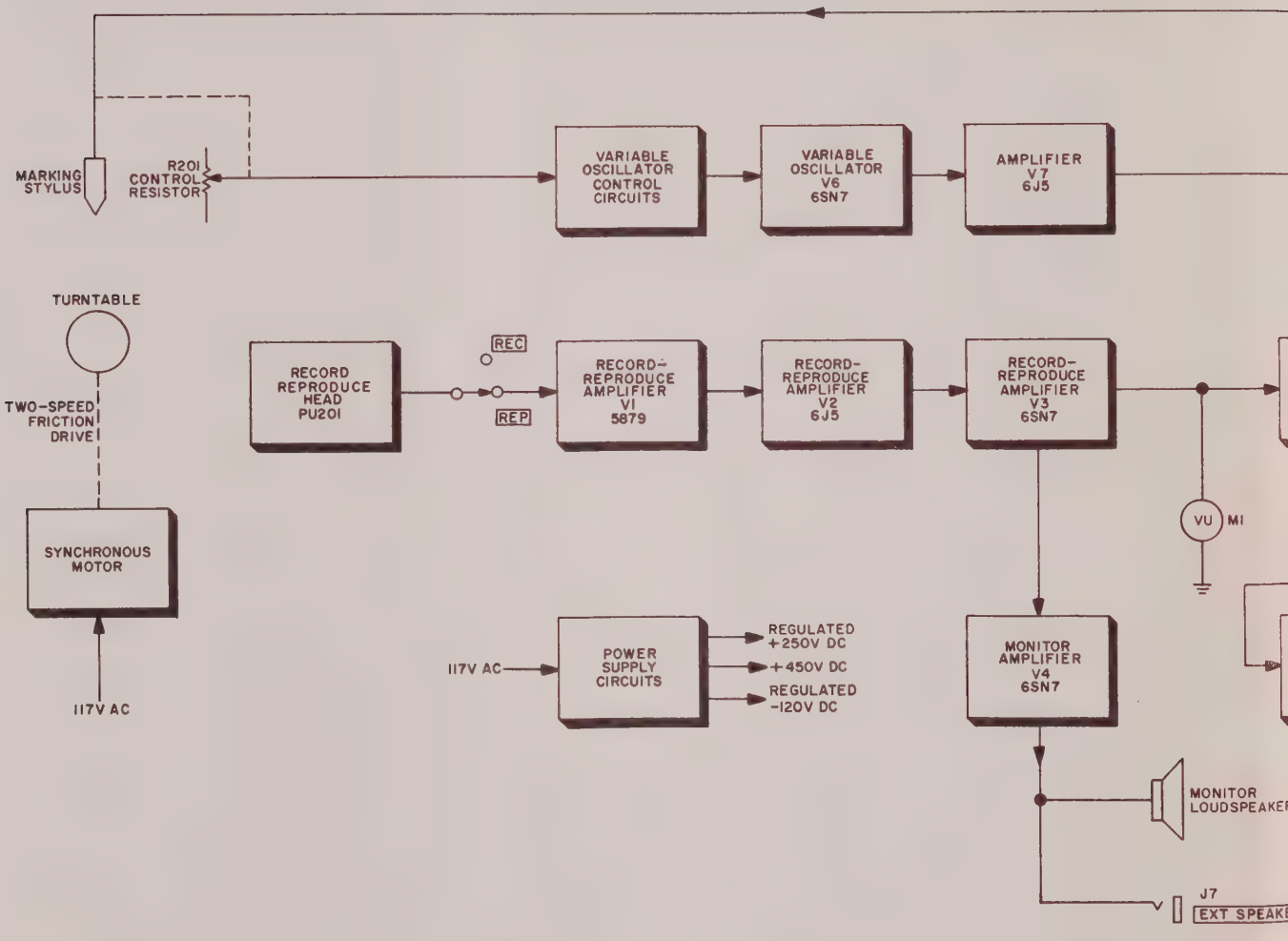


FIGURE 5-1 FUNCTIONAL BLOCK DIAGRAM (Record Mode)


MARKING STYLUS
R201 CONTROL RESISTOR
VARIABLE OSCILLATOR CONTROL CIRCUITS
VARIABLE OSCILLATOR V6 6SN7
AMPLIFIER V7 6J5
TURNTABLE
TWO-SPEED FRICTION DRIVE
SYNCHRONOUS MOTOR
117V AC
RECORD REPRODUCE HEAD PU201
REC
REP
RECORD-REPRODUCE AMPLIFIER V1 5879
RECORD-REPRODUCE AMPLIFIER V2 6J5
RECORD-REPRODUCE AMPLIFIER V3 6SN7
VU M1
117V AC
POWER SUPPLY CIRCUITS
REGULATED +250V DC
+450V DC
REGULATED -120V DC
MONITOR AMPLIFIER V4 6SN7
MONITOR LOUDSPEAKE
J7
EXT SPEAK

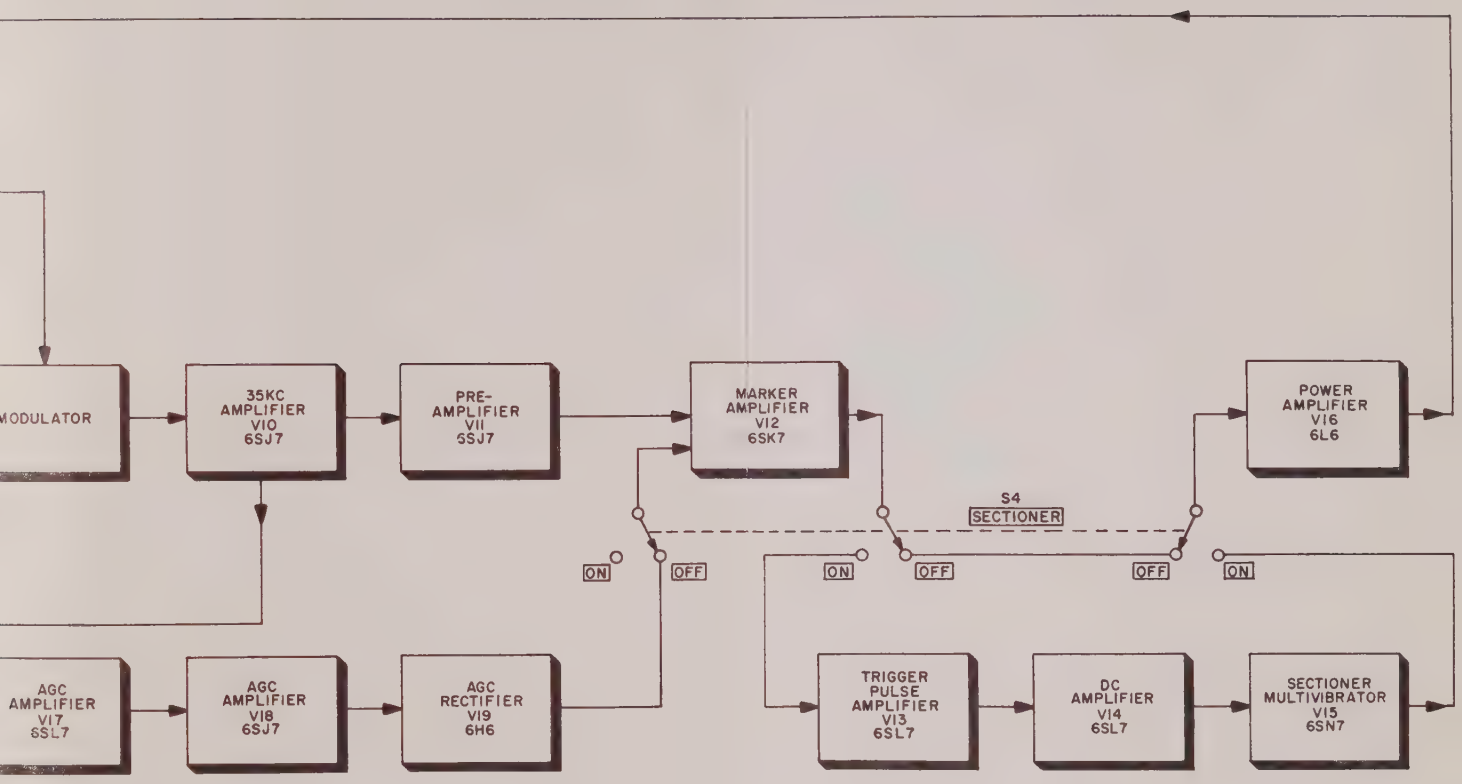


FIGURE 5-2 FUNCTIONAL BLOCK DIAGRAM (Reproduce Mode)

SECTION VI

MAINTENANCE

6-1 OPERATIONAL CHECKS AND CALIBRATION

This section provides instructions for a checkout and calibration of individual circuits, or when accomplished in its entirety, comprises an over-all realignment of the circuitry.

Voltage tables are furnished as well as voltage gain, which is given in db above or below a level of 1 millivolt, as indicated on an a-c voltmeter.

a. Test Equipment Required.

(1) Vacuum-tube-voltmeter (VTVM), RCA VoltOhmyst, or equivalent, for measuring resistance, and a-c and d-c voltages.

(2) AC vacuum-tube-voltmeter (ac voltmeter), Ballantine Model 310A, or equivalent, for measuring signal levels.

(3) Oscilloscope, Tektronix Model 504B, or equivalent, for displaying test signals.

(4) Audio Oscillator (oscillator), Hewlett-Packard Model 200CD, or equivalent, for generating test signals.

(5) Bulk tape eraser (eraser) Amplifier Corp., Magneraser Model 200C, or equivalent, for demagnetizing magnetic strip.

(6) Tape head demagnetizer (demagnetizer), Audio Devices Model 400, or equivalent, for demagnetizing record-reproduce and erase heads.

(7) Berkeley/Beckman frequency counter Model #554 or equivalent, for measuring frequencies.

b. Voltage Checks.

(1) Connect the VTVM to test jacks TP-1 (ground) and TP-6, and adjust potentiometer R-326 on the top of the power supply chassis until the VTVM indicates 250 volts.

(2) Connect the VTVM to test jacks TP-1 (ground) and TP-3, the VTVM should indicate -115 ±5 volts dc.

(3) Connect the VTVM between pins 9 or 10 of connector J-4 of the amplifier-analyzer (or connector J-301 of the power supply). The VTVM should indicate 6.0 ±0.3 volts ac.

(4) Connect the a-c voltmeter as in step (1) to measure power supply ripple. The a-c voltmeter should indicate a maximum of 3 millivolts.

(5) Connect the a-c voltmeter as in step (2) to measure power supply ripple. The a-c voltmeter should indicate a maximum of 3 millivolts.

c. Bias-Erase Oscillator, Alignment.

(1) Set REC - REP switch of the amplifier-analyzer to REC and REC-REP LEVEL control fully counterclockwise.

(2) Connect the a-c voltmeter and the oscilloscope across resistor R-202 (connected in series with record-reproduce head, and located on the recorder).

(3) Set RECORD - OFF - REPROD. lever on the recorder to RECORD. The turntable should rotate.

(4) Adjust capacitor C-37 of the amplifier-analyzer (located on the turret of the tube socket for bias-erase oscillator tube V-5), until the a-c voltmeter indicates between 100 and 200 millivolts, and the oscilloscope displays a 75-kc signal.

(5) Set RECORD - OFF - REPROD. lever on the recorder to OFF, and disconnect the a-c voltmeter and oscilloscope.

(6) Connect the a-c voltmeter and the oscilloscope across resistor R-203 (connected in series with the erase head, and located on the recorder).

(7) Set RECORD - OFF - REPROD. lever of the recorder to RECORD. The turntable should rotate, the a-c voltmeter whould indicate between 1.6 and 2.2 volts, and the oscilloscope should display a clean sine wave of 75 kc.

(8) Set RECORD - OFF - REPROD. lever of the recorder to OFF, and disconnect the a-c voltmeter and the oscilloscope.

d. Record-Reproduce and Erase Head Demagnetizing. (Only when necessary.)

(1) Use the ratchet of the head mounting brackets to move both heads away from the magnetic strip.

(2) Check to see that ON - OFF switch of the amplifier-analyzer is set to OFF, the RECORD - OFF - REPROD. lever of the recorder is set to OFF, and disconnect cable No. 3.

(3) Using the demagnetizer, lightly touch the pole face of the record-reproduce head, and slowly draw the demagnetizer away until it is at least 12 inches from the head.

(4) Repeat step (3) for the erase head.

(5) Replace cable No. 3, reset the record-reproduce and erase heads, and adjust the contact pressure.

e. Magnetic Strip Demagnetizing. (Only when necessary).

(1) Check to see that ON - OFF switch of the amplifier-analyzer and RECORD - OFF - REPROD. lever of the recorder are set to OFF.

(2) Slowly rotate the turntable (manually, or using an external drive) at about 3 rps. Energize the eraser several feet away from the turntable, and slowly bring the eraser up to the magnetic strip.

CAUTION: Be careful not to scratch the magnetic strip. If necessary, place a layer of cellophane or "Mylar" tape over the pole-face area of the eraser.

Do not energize or de-energize the eraser within 3 feet of the turntable. The initial and terminal transients can cause permanent magnetization of the turntable.

(3) Slowly draw the eraser away from the magnetic strip until it is at least three feet away from the turntable, then de-energize it.

f. Record-Reproduce Head Alignment.

Adjust record-reproduce and erase heads as follows:

(1) Connect the a-c voltmeter and oscilloscope across resistor R-202 (in series with the record-reproduce head).

(2) Set REC - REP switch to REC, and RECORD - OFF - REPROD. lever to RECORD.

(3) Inject a 2500-cps signal from the audio oscillator to Microphone Jack J-6.

(4) Disable bias-erase oscillator tube V-5, by holding switch S-6, located on the top of the amplifier-analyzer chassis, in the OFF position.

(5) Adjust the output level of the audio oscillator until the a-c voltmeter indicates between 11 and 13 millivolts. The oscilloscope should display a clean 2500-cps, sine wave. Disconnect the oscilloscope and release switch S-6.

(6) Set the oscillator output level to zero. The a-c voltmeter should indicate between 100 and 200 millivolts.

(7) Adjust the oscillator output level until VU meter indicates approximately 0 VU, and allow recording to be produced for at least 15 seconds.

(8) Set REC - REP switch to REP, and RECORD - OFF - REPROD. lever to REPROD.

(9) Reconnect the a-c voltmeter so that it is across record-reproduce head and resistor R-202, and disconnect the oscillator.

(10) Using the setscrews of the record-reproduce head mounting bracket, adjust the alignment of the head for a maximum output indication on the a-c voltmeter. A-c voltmeter should indicate approximately 13 millivolts (22 db).

(11) A low indication in step (10) may be due to dirt on the magnetic strip or improper head pressure. Clean the magnetic strip and readjust record-reproduce head; repeat the test.

(12) Disconnect the a-c voltmeter.

g. Record-Reproduce Amplifier Hum and Noise.

(1) Set REC - REP switch to REP, and remove tubes V-5 and V-6 from the amplifier-analyzer chassis.

(2) Set REC-OFF-REPROD lever to REPRO (turntable not running).

(3) Connect the a-c voltmeter between TP-10 and ground.

(4) Set REC-REP LEVEL control fully clockwise. The a-c voltmeter should indicate about 93 millivolts (39.5 db). As REC-REP LEVEL control is rotated counterclockwise, a-c voltmeter indication should decrease.

(5) ~~Replace tubes V-5 and V-6.~~

h. Record-Reproduce Amplifier Gain- Reproduce Mode.

(1) Set REC-REP switch to REP, and remove tubes V-5, V-6, and V-7 from the amplifier-analyzer chassis.

(2) Slowly slide RECORD-OFF-REPROD. lever toward REPROD. until a click is heard indicating control relay operation. Do not move lever beyond this point to engage turntable.

(3) Connect the oscillator across resistor R-202 (in series with record-reproduce head) and adjust the output for 1000 cps at 2 millivolts.

(4) Set REC-REP LEVEL at max.

(5) Set FL-1 - HS - FL2 switch to FL-1. The VU meter should indicate zero VU ±1.

(6) Set FL-1 - HS - FL-2 switch to HS. The VU meter should indicate zero VU ±1.

(7) Set FL-1 - HS - FL-2 switch to FL-2. The VU meter should indicate -2 VU ±1.

(8) ~~Replace V-5, 6 & 7.~~

i. Record-Reproduce Amplifier Gain - Record Mode.

(1) Set REC - REP switch to REC, FL-1 - HS - FL-2 switch to FL-1, and remove tubes V-5, V-6 and V-7 from the amplifier-analyzer.

(2) Set LINE - MIKE switch to MIKE, and connect the oscillator to the MICROPHONE jack. Connect a 22-ohm resistor between the output terminals of the oscillator, and connect a jumper from the sleeve to the ring contacts of the connector. This provides a 22-ohm, unbalanced input to the analyzer.

(3) Slide RECORD - OFF - REPROD. lever toward RECORD until click is heard indicating that the control relay is energized. Do not move the lever beyond this point; turntable should not rotate.

-8VU

(4) Adjust the oscillator for 1000-cps, 1.5-millivolt output, and adjust REC-REP LEVEL control for an indication of zero VU ± 1.0 on the VU meter (16 to 20 on REC-REP LEVEL control).

9.5mV

(5) Connect the a-c voltmeter across resistor R-202, in series with the record-reproduce head. The a-c voltmeter should indicate 11 to 13 millivolts.

(6) Adjust REC-REP LEVEL control for a -5 VU ±1.0 indication on the VU meter.

-5

(7) Set FL-1 - HS - FL-2 switch to HS, and then to FL-2. The VU meter indication should differ by 2.0 VU.

(8) Vary REC-REP LEVEL control, with and without signal input, and observe VU meter and a-c voltmeter for irregular variation at each position of FL-1 - HS - FL-2 switch.

j. Record-Reproduce Amplifier-Frequency Response.

(1) With the oscillator and the a-c voltmeter connected as in paragraph i (steps 1 thru 5), adjust the oscillator for 1.5-millivolt output at 1000 cps.

(2) Set REC - REP switch to REC, and FL-1 - HS - FL-2 switch to FL-1.

(3) Adjust REC-REP LEVEL control for a VU meter indication of 0 VU ±1.0 and record the a-c voltmeter reading.

(4) Record a-c voltmeter reading for frequencies in Table 6-1. Adjust the oscillator to the required frequency, and for 1.5-millivolt output. Do not touch the setting of REC-REP LEVEL control between measurements.

(5) Repeat steps (3) and (4) with FL-1 - HS - FL-2 switch set to HS or to FL-2.

(6) The recorded indications should agree with the listing of Table 6-1 within ±2.0 db.

TABLE 6-1

A-C Voltmeter Indication Across R-202 with FL-1 - HS - FL-2 Switch Set To:				
Frequency (cps)	FL-1 (millivolts)	(db)	HS or FL-2 (millivolts)	(db)
100	14.0	23.00	14.0	23.00
200	14.75	23.25	12.25	21.75
500	13.25	22.50	11.5	21.63
1000	12.75	22.13	13.0	22.25
2000	12.75	22.13	23.9	27.5
4000	12.75	22.13	47.0	33.5
6000	13.0	22.25	63.0	36.0
8000	13.25	22.50	70.0	37.0

k. Overall Response of Record-Reproduce Amplifier.

(1) With the oscillator and a-c voltmeter connected as in paragraph i (steps 1 thru 5), adjust the oscillator for 2.0-millivolt output at 1000 cps.

(2) Set REC - REP switch to REC and FL-1 - HS - FL-2 switch to FL-1.

(3) Set REC-REP LEVEL control for a VU-meter reading between -0.5 and +0.5 VU.

(4) Connect the a-c voltmeter to pin 4 of tube socket XV-3.

(5) Do not touch the setting of REC-REP LEVEL control for the balance of this test. Adjust the oscillator frequency to the values indicated in Table 6-2, setting the output level of the oscillator to 2 millivolts at each step. Compare the measured values with those listed in Table 6-2. Repeat this test with the a-c voltmeter connected between test jack TP-10 and TP-1.

(6) Set FL-1 - HS - FL-2 switch to HS.

(7) Set REC - REP LEVEL control to #20.

(8) Set the oscillator at 8000 cps and adjust output level to give +3 VU.

(9) Connect the a-c voltmeter to pin 4 of tube socket XV-3.

TABLE 6-2

AC Voltmeter Connected At:					
Frequency (cps)	VU Meter Indication	XV3-4 (volts)	XV3-4 (db range)	TP-10 (volts)	TP-10 (db range)
100	+2.0	1.33	60.5 - 64.5	0.53	52.5 - 56.5
200	+1.0	1.35	59.4 - 63.4	0.62	54.0 - 58.0
500	+0.25	1.33	60.5 - 64.5	0.63	54.25 - 58.25
1000	0 (Ref.)	1.35	60.6 - 64.6	0.64	54.3 - 58.3
2000	0	1.35	60.6 - 64.6	0.64	54.3 - 58.3
4000	-0.25	1.33	60.5 - 64.5	0.64	54.3 - 58.3
6000	-0.3	1.35	59.3 - 63.3	0.55	52.8 - 56.8
8000	-0.7	1.1	59.0 - 63.0	0.47	51.6 - 55.6

(10) Maintain constant input for frequencies listed in Table 6-3.

TABLE 6-3

AC Voltmeter Connected At:					
Frequency (cps)	VU Meter Indication	XV3-4 (volts)	XV3-4 (db range)	TP-10 (volts)	TP-10 (db range)
1000	-9.5	0.335	48.5 - 52.5	0.173	42.7 - 46.7
2000	-6.3	0.52	52.25 - 56.25	0.25	46.0 - 50.0
4000	-1.5	1.08	58.75 - 62.75	0.48	51.7 - 55.7
6000	+1.7	1.45	61.2 - 65.2	0.73	55.3 - 59.3
8000	+3.0 (Ref)	1.65	62.3 - 66.3	0.82	56.3 - 60.3

(11) Set FL-1 - HS - FL-2 switch to FL-2.

(12) Set REC-REP LEVEL control to #20.

(13) Set the oscillator at 8000 cps and adjust output level to give +3 VU.

(14) Maintain constant input for frequencies listed in Table 6-4.

TABLE 6-4

Frequency (cps)	VU Meter Indication	AC Voltmeter Connected At: XV3-4 (volts)	XV3-4 (db range)	TP-10 (volts)	TP-10 (db range)
100	-11.0	0.195	43.7 - 47.7	0.115	39.25 - 43.25
200	-11.5	0.21	44.4 - 48.4	0.133	40.5 - 44.5
500	-10.5	0.275	46.85 - 50.85	0.128	40.2 - 44.2
1000		0.330	48.3 - 52.3	0.15	41.5 - 45.5
2000	-6.0	0.500	52.0 - 56.0	0.236	45.5 - 49.5
4000		1.05	58.5 - 62.5	0.455	51.2 - 55.2
6000		1.42	61.1 - 65.1	0.69	54.8 - 58.8
8000	+3.0 (Ref)	1.62	62.2 - 66.2	0.79	56.0 - 60.0

1. Record-Reproduce System Overall Response.

(1) Check to see that REC-REP switch is set to REC, LINE-MIKE switch is set to MIKE, FL-1 - HS - FL-2 switch is set to FL-1, BAND SELECTOR switch is set to NARROW, FREQ SPREAD switch is set to NORM, SMALL DRUM - LARGE DRUM switch is set to SMALL DRUM, INVERT BURN - FREQ NORMAL switch is set to FREQ NORMAL; set MARK LEVEL control to 7½. Replace tubes V-5, V-6 and V-7, and connect the oscillator and the a-c voltmeter as in paragraph i (1 thru 5).

(2) Adjust the output of the oscillator for 2 millivolts at 1000 cps, across MICROPHONE jack.

(3) Set RECORD - OFF - REPROD lever of the recorder to RECORD.

(4) Set REC - REP LEVEL control for a VU meter indication between -0.5 and +0.5 VU. Note setting of level control.

(5) Set REC - REP switch to REP, then set RECORD - OFF - REPROD. lever to REPROD.

(6) Connect the a-c voltmeter to pin #4 of secket XV-3, and set REC - REP LEVEL control to approximately zero VU, and note setting of LEVEL control.

(7) Repeat steps (2) through (6) with a 100-cps input at 2 millivolts. Record the peak a-c voltmeter indication. The a-c voltmeter reading should correspond with the listing in Table 6-5 within ±2 db. Also measure the voltage at TP-10. Compare these readings with the listings below to isolate possible troubles.

(8) For TP-2 readings, manually raise the stylus control lever and note that the a-c voltmeter indication peaks as the stylus passes through the indicated frequency point.

NOTE: A sharp drop in the output voltage, as the frequency is increased, indicates improper head alignment; check REC - REP head per paragraph f. Higher output readings are acceptable, as long as they meet the specifications of 4.0 db total excursion. For poor Record-Reproduce Amplifier response, repeat paragraphs f and k.

TABLE 6-5

OUTPUT LEVEL (in db) AT TEST POINTS:				
Frequency	XV3-4	TP-10	Modulator Terminal 2	TP-2
100	62.00	56.00	30.50	86.50
200	62.50	56.50	31.50	86.50
300	62.25	55.75	31.00	86.00
400	61.75	55.50	30.75	86.50
500	61.50	55.00	30.50	86.50
600	61.50	55.00	30.50	86.50
700	61.25	54.75	30.50	87.00
800	61.00	54.50	30.25	86.50
900	60.75	54.25	30.00	86.50
1000	61.00	54.25	30.00	87.00
2000	61.00	54.00	30.00	86.00
3000	61.00	53.50	30.00	86.50
4000	60.50	53.00	29.75	87.00
5000	59.75	52.50	29.00	86.50
6000	59.25	52.50	29.00	86.50
7000	59.00	53.50	29.75	86.50
8000	58.50	54.50	30.50	85.50

Note: Readings at TP-2 and Modulator Terminal 2 should be taken after completion of steps 'm' through 's' inclusive.

m. 35-Kc Amplifier Gain and Bandwidth.

(1) Remove tubes V-5, V-6, and V-7.

(2) Set REC - REP switch to REP, BAND SELECTOR switch to NARROW, LARGE DRUM - SMALL DRUM switch to SMALL DRUM, and adjust MARK LEVEL control to approximately #5 and raise stylus to approximately midpoint of travel, and away from drum.

(3) Connect the output of the oscillator to terminal 2 of the modulator. Adjust the oscillator for an output of 56 millivolts at 35 kc.

(4) Connect the a-c voltmeter between test jacks TP-5 and TP-1.

(5) Adjust the frequency of the oscillator for a maximum indication on the a-c voltmeter. Compare the frequency and voltage obtained with the listing in Table 6-6.

(6) Move the a-c voltmeter connection from test jack TP-5 to test jack TP-2 and compare the indication with the listing in Table 6-6. Reconnect the a-c voltmeter to test jack TP-5.

(7) Adjust the oscillator frequency to the 3-db down points at either side of the center frequency, obtained in step (5). Compare the frequencies obtained with the listing in Table 6-6.

TABLE 6-6

BAND SELECTOR Switch Setting	Center Frequency	Output				Bandwidth*
		TP-5 (volts)	(db)	TP-2 (volts)	(db)	
NARROW	35.0 ±0.2 kc	Min. 3.0	69.5	Min. 15	86.0	150 ±50 cps
WIDE	34.6 ±0.4 kc	Min. 3.0	69.5	Min. 15	86.0	1000 ±300 cps

*Use Freq. Counter

Note: Counter loads circuit. Do not connect when taking voltage measurements.

(8) Repeat steps (4) through (7) with BAND SELECTOR switch to WIDE.

n. Marker Amplifier Gain and Bandwidth.

(1) Replace tubes V-5 and V-7; leaving tube V-6 out of its socket.

(2) Check to see that SECTIONER switch is set to OFF, REC - REP switch set to REP, SMALL DRUM - LARGE DRUM switch set to SMALL DRUM, BAND SELECTOR set to NARROW, and MARK LEVEL control set to its fully clockwise position.

(3) Set the stylus to the approximate mid-point of travel, and aw y from the drum.

(4) Connect the oscillator to test jack TP-5, an' adjust the output for 35.0 ±0.4 kc and 300 millivolts.

(5) Connect the a-c voltmeter between test jacks TP-2 and TP-1.

(6) Adjust the oscillator frequency for a peak indication on the a-c voltmeter (approx. 15 volts). Compare the frequency and the input and output voltages with those given in Table 6-7.

(7) Adjust the oscillator for the 3-db down points at either side of the center frequency established in step (6). Compare the value obtained with the listing in Table 6-7.

TABLE 6-7

Center Frequency	Input Voltage	Output Voltage	Bandwidth (cps)*
35.0 ±0.2 kc	300 millivolts (or less)	15.2 volts	1150 ±300

*Use Freq. Counter.

Note; Counter loads circuit. Do not connect when taking voltage measurements.

(8) Reset the oscillator to the condition of step (6). Using the a-c voltmeter, measure the voltage across the marking stylus. The voltage should be at least 150 volts.

o. Overall Gain and Bandwidth of 35-KC Amplifier and Marking Amplifier.

(1) Remove tubes V-5 and V-7.

(2) Check to see that MARK LEVEL control is set to approx. #5, SECTIONER switch is set to OFF, REC-REP switch is set to REP.

(3) Set the stylus to the approximate mid-point of travel, and away from the drum.

(4) Connect the oscillator to terminal 2 of the modulator, and adjust the output to 35 kc at 56 mv.

(5) Connect the a-c voltmeter between test jacks TP-2 and TP-1.

(6) With BAND SELECTOR switch set to NARROW, adjust the oscillator frequency for a maximum indication on the a-c voltmeter. Compare the voltage and frequency thus obtained with the values given in Table 6-8.

(7) Determine the bandwidth by adjusting the oscillator frequency to the 3-db down points at either side of the center frequency from step (6). Compare the bandwidth obtained with the listing in Table 6-8.

TABLE 6-8

BAND SELECTOR Switch Setting	Center Frequency	Input Voltage	Bandwidth*	Output Voltage
NARROW	35.0 ±0.4 kc	56 mv	150 ±50 cps	15 volts (min.)
WIDE	35.0 ±0.4 kc	56 mv	1000 ±300 cps	15 volts (min.)

*Use Freq. Counter

Note: Counter loads circuit. Do not connect when taking voltage measurements.

p. Balance of Modulator to Variable Oscillator.

(1) Check to see that SMALL DRUM - LARGE DRUM switch is set to SMALL DRUM, INVERT BURN - FREQ. NORMAL switch is set to FREQ. NORMAL, REC-REP switch is set to REP, REC-REP LEVEL control is set to 32, BAND SELECTOR switch is set to NARROW, MARK LEVEL control is set fully clockwise, and FREQ SPREAD switch is set to NORM.

(2) Check to see that the stylus assembly is positioned just above the lower short point and not in contact with the drum.

(3) Connect the a-c voltmeter and oscilloscope between test jacks TP-2 and TP-1.

(4) Adjust R-144, on the top of the amplifier-analyzer chassis, for a 35-kc signal (carrier leak) as indicated on the oscilloscope.

(5) Adjust MARK LEVEL control, are required, to maintain a maximum indication of 20 volts on the a-c voltmeter.

(6) With BAND SELECTOR switch set to WIDE, adjust R-141, on the top of the amplifier-analyzer chassis for a minimum indication on the a-c voltmeter of 12 volts, or less.

q. AGC Response.

(1) Check to see that REC-REP switch is set to REP, BAND SELECTOR switch is set to WIDE, REC-REP LEVEL control is set fully counterclockwise.

(2) Remove tube V-7.

(3) Connect the VTVM across R-142, on the underside of the amplifier-analyzer chassis. Set R-142, on the top of the chassis, to 1.

(4) Connect the oscillator to terminal 2 of the modulator and adjust the output for 100 millivolts at 35 ±1 kc. Connect the a-c voltmeter across the output of the aucio oscillator.

(5) The VTVM should indicate a negative voltage.

(6) Compare the VTVM indication for the various input signal levels as indicated in Table 6-9. Adjust the oscillator for the output levels required.

TABLE 6-9

VTVM Indication with BAND SELECTOR Switch Set To:					
Input Level (a-c voltmeter)	WIDE	NARROW	Input Level (a-c voltmeter)	WIDE	NARROW
-5 db	-1.2V	-1.6V	+20 db	-5.3V	-5.7V
0 db (1 mv)	-1.5	-2.2	+25 db	-6.0	-6.6
+5 db	-2.5	-3.1	+30 db	-7.2	-8.0
+10 db	-3.5	-4.0	+35 db	-9.6	-10.2
+15 db	-4.5	-4.8	+40 db (100 mv)	-12.9	-13.2

(7) Repeat step (6) with BAND SELECTOR switch set to NARROW, and the input signal at 35 ±0.4 kc. Adjust the oscillator frequency, if necessary, for a peak VTVM indication.

r. Variable Oscillator.

(1) Determine that FREQ SPREAD switch is set to NORM, LARGE DRUM - SMALL DRUM switch is set to SMALL DRUM, INVERT BURN - FREQ NORMAL switch is set to FREQ NORMAL. REC-REPROD switch in REPROD position.

(2) Using the a-c voltmeter, measure the output between test jacks TP-9 and TP-1. The output should be a minimum of 1 volt.

(3) Connect the oscilloscope between test jacks TP-9 and TP-1, and the VTVM from TP-8 to TP-1.

(4) Slowly raise the stylus, by hand, from the bottom to the top of the stroke. Do not allow the stylus to come into contact with the drum.

(5) As the stylus is raised, the frequency indicated on the oscilloscope should vary from 35 kc to 61.7 kc approx., and the voltage indicated on the VTVM should increase.

s. Frequency Range Adjustment.

(1) Check to see that FREQ SPREAD is set to NORM, LARGE DRUM - SMALL DRUM switch is set to SMALL DRUM, INVERT BURN - FREQ NORMAL switch is set to FREQ NORMAL.

(2) REC-REPROD switch in REPROD position.

(3) BAND SELECTOR in NARROW position.

(4) SECTIONER switch OFF.

(5) Connect the a-c voltmeter and oscilloscope between test jacks TP-2 and TP-1.

(6) Turn AGC control, pot R-142, counterclockwise to #1; turn MARK LEVEL completely clockwise.

(7) Connect d-c VTVM between TP-7 and TP-1.

(8) Raise stylus just above lower short point, adjust R-144 for maximum carrier voltage.

(9) Move stylus up, just below upper short point. Connect audio oscillator, tuned to 26.7 kc, to top of TP-10 voltage divider (junction of C-9 & R-23). Adjust for +3.0 VU input. Adjust R-143 for peak voltage at test jack TP-2.

(10) Remove signal generator from top of TP-10 voltage divider and check for carrier leak at lower short limit by observing oscilloscope, connected at TP-2.

(11) Repeat steps (8), (9) and (10) until correct frequency limits are obtained.

(12) Set FREQ - SPREAD switch to 85 cps - 4 kc position.

(13) Raise stylus just above lower short point, adjust R-149 for maximum carrier voltage.

(14) Move stylus up, just below upper short point. Connect audio oscillator, tuned for 13.3 kc to top of TP-10 voltage divider (junction of C-9 & R-23). Adjust for +3.0 V.U. input. Adjust R-148 for peak voltage at test jack TP-2.

(15) Remove signal generator from top of TP-10 voltage divider and check for carrier leak at lower short limit by observing oscilloscope connected at TP-2.

(16) Repeat steps (13, (14) and (15) until correct frequency limits are obtained.

(17) Set FREQ SPREAD switch to 4 KC - 8 KC position.

(18) Connect signal generator to top of TP-8 voltage divider (junction of C-9 & R-23). Adjust for +3.0 VU input. Set signal generator for 13.3 kc.

(19) Raise stylus just above lower short point, adjust R-151 for a peak voltage at test jack TP-2.

(20) Move stylus up, just below upper short point, with audio oscillator, tuned for 26.7 kc. Adjust oscillator for +3.0 VU input. Adjust R-150 for peak voltage at test jack TP-2.

(21) Retune oscillator for 13.3 kc and adjust R-151 again for a peak voltage at test jack TP-2.

(22) Repeat steps (19), (20) and (21) until correct frequency limits are obtained for this range.

(23) Disconnect test equipment.

t. Operation of INVERT BURN - FREQ NORMAL Switch.

NOTE: Be sure all power to the analyzer is disconnected before performing steps (1) through (4).

(1) Check to see that FREQ SPREAD switch is set to NORM, and INVERT BURN - FREQ NORMAL switch is set to FREQ NORMAL.

(2) Connect the VTVM, set to the resistance ranges, between test jack TP-8 and the common contact of switch S-7, connecting potentiometers R-144B, R-149B and R-151B.

(3) Manually raise the stylus from the rest position to the top of the marking area. The VTVM indication should increase from 0 to 7000 ohms. Reset the stylus.

NOTE: 0 ohms, in this test, refers to a minimum value between 240 and 600 ohms.

(4) Set INVERT BURN - FREQ NORMAL switch to INVERT BURN, and repeat step (3). The VTVM indication should decrease from 7000 ohms to 0. Leave the stylus in position at the top of the marking area.

(5) Disconnect the VTVM, set LARGE DRUM - SMALL DRUM switch to SMALL DRUM, INVERT BURN - FREQ NORMAL switch to FREQ NORMAL, FREQ SPREAD switch to 85 cps - 4 KC, and apply power to the analyzer.

(6) Connect the a-c voltmeter and the oscilloscope between test jacks TP-2 and TP-1.

(7) Set the oscillator for an output of 13.3 ±0.1 kc, and connect it to top of TP-10 voltage divider and TP-1. Adjust the output frequency for a peak indication on the VU meter, and the output level for an indication of at least -2.

(8) Lower the stylus to the bottom of the marking area, and disconnect the oscillator. The oscilloscope should indicate only carrier leakage.

NOTE: When adjusting stylus position during this test, do not allow the stylus to touch the drum.

(9) Set INVERT BURN - FREQ NORMAL switch to INVERT BURN, and reconnect the oscillator. The a-c voltmeter and the oscilloscope should indicate maximum signals.

(10) Move the stylus to the top of the marking area and disconnect the oscillator. The oscilloscope should indicate only carrier leakage.

(11) Set INVERT BURN - FREQ NORMAL switch to FREQ NORMAL, and reconnect the oscillator. The a-c voltmeter and the oscilloscope should indicate maximum signals.

(12) Disconnect the oscillator. The oscilloscope should indicate no signal.

(13) Move the stylus to the bottom of the marking area and set FREQ SPREAD switch to NORMAL. The oscilloscope should indicate only carrier leakage.

(14) Set the oscillator for an output of 26.7 ±0.1 kc, and reconnect it. Adjust the output frequency for a peak VU meter indication, and the output level for an indication of at least -2.

(15) Set INVERT BURN - FREQ NORMAL switch to INVERT BURN. The a-c voltmeter and the oscilloscope should indicate a maximum signal.

(16) Disconnect the oscillator, and move the stylus to the top of the marking area. The oscilloscope should indicate only carrier leakage.

(17) Reconnect the oscillator, and set INVERT BURN - FREQ NORMAL switch to FREQ NORMAL. The a-c voltmeter and the oscilloscope should indicate a maximum signal.

(18) Disconnect the oscillator, and set the stylus to the bottom of the marking area. The oscilloscope should indicate only carrier leakage.

(19) Set FREQ SPREAD switch to 4KC/8KC. The oscilloscope should indicate no signal.

(20) Reconnect the oscillator and adjust it in accordance with step (7). The oscilloscope should indicate a maximum signal.

(21) Set INVERT BURN - FREQ NORMAL switch to INVERT BURN. The a-c voltmeter and the oscilloscope should indicate no signal.

(22) Reset the oscillator frequency to 26.7 $\pm$0.1 kc in accordance with step (14). The a-c voltmeter and the oscilloscope should indicate a maximum signal.

(23) Move the stylus to the top of the marking area. The oscilloscope should indicate no signal.

(24) Set INVERT BURN - FREQ NORMAL switch to FREQ NORMAL. The a-c voltmeter and the oscilloscope should indicate a maximum signal.

(25) Adjust the oscillator in accordance with step (7). The oscilloscope should indicate no signal.

(26) Set INVERT BURN - FREQ NORMAL switch to INVERT BURN. The a-c voltmeter and the oscilloscope should indicate a maximum signal.

(27) Reset the oscillator in accordance with step (14), and move the stylus to the bottom of the marking area. The oscilloscope should indicate a maximum signal.

(28) Reset the oscillator in accordance with step (7). The oscilloscope should indicate no signal.

(29) Set INVERT BURN - FREQ NORMAL switch to FREQ NORMAL. The a-c voltmeter and the oscilloscope should indicate a maximum signal.

(30) Disconnect the test equipment.

NOTE: Be sure to vary frequency dial of oscillator in order to obtain maximum indication.

u. Sectioner.

(1) Remove tubes V-6 and V-7.

(2) Check to see that the 4-inch drum is in place, LARGE DRUM-- SMALL DRUM switch is set to SMALL DRUM, SECTIONER switch is set to ON, BAND SELECTOR

switch is set to NARROW, REC-REP LEVEL control is set to the fully counterclockwise position, and REC - REP switch is set to REP.

(3) Install paper on the small drum.

(4) Connect the a-c voltmeter between pin 8 of XV-12 and test jack TP-1, and the oscilloscope between test jacks TP-2 and TP-1.

(5) Connect the oscillator between test jacks TP-5 and TP-1, and set it for an output of 35 kc.

(6) Set MARK LEVEL control to 7-1/2, and RECORD-OFF-REPROD. lever to REPROD.

(7) Raise stylus above lower short point and adjust the output of the oscillator for a 1-volt indication on the a-c voltmeter.

(8) Place 5 pins around the periphery of the small drum, 12 holes apart.

(9) Disengage the sectioner microswitch lock screw, and check to see that the roller arm of the microswitch trips the pins as the turntable rotates.

(10) Engage the stylus with the paper.

(11) Adjust R-146, on the top of the amplifier-analyzer chassis, for a line length of 6 to 8 millimeters on the paper.

(12) Adjust R-147, on the top of the amplifier-analyzer chassis, for a suitable marking intensity on the paper. If the last 1/4-inch of the reproduced line varies in intensity, reset R-147.

(13) Increase the output of the oscillator for an indication of 56 volts on the a-c voltmeter.

(14) Adjust R-145, on the top of the amplifier-analyzer chassis, for a line length of 41 to 43 millimeters.

(15) Decrease the output of the oscillator in 5 db increments as indicated on the a-c voltmeter. The length of the reproduced lines should decrease uniformly (approximately 5 millimeters per 5 db increment).

(16) Disconnect the test equipment and replace tubes V-6 and V-7.

v. Wow and Flutter.

(1) Check to see that REC - REP switch is set to REP, FREQ SPREAD switch is set to NORM, BAND SELECTOR is set to NARROW, and INVERT BURN - FREQ NORMAL switch is set to FREQ NORMAL. Connect oscilloscope between TP-2 and TP-1.

(2) Connect the output of the oscillator to MICROPHONE jack.

(3) Adjust the oscillator for an output of 7 kc, and a -3 VU indication on the VU meter. Adjust REC-REP LEVEL control as required.

(4) Set RECORD-OFF-REPROD. lever to RECORD, and allow the input signal to be recorded. Set REC-REP switch to REP.

(5) Set RECORD-OFF-REPROD lever to OFF, disconnect the oscillator, and install chart paper.

(6) Set RECORD-OFF-REPROD lever to REPROD and manually move the stylus until a signal is indicated on the oscilloscope (indication passes through a peak). Do not allow the stylus to touch the paper.

(7) Set MARK LEVEL control to 3, and adjust REC-REP LEVEL control for an indication of -3 VU on the VU meter.

(8) Set the stylus to engage the leadscrew at some point below the area where the signal will be reproduced, and allow the graph to be recorded.

(9) Set all controls of the analyzer to OFF, and remove the chart. Examine the chart with a straight edge along the reproduced line. The maximum waver of the line should be 1/16 of an inch peak-to-peak. A single waver indicates wow, eccentricity or other variations in the turntable; multiple wavers indicate flutter, generally due to flat spots on the drive wheels.

TROUBLE SHOOTING

6-2 INTRODUCTION.

Troubleshooting procedures are provided to aid the technician in isolating defective parts of the analyzer when faulty equipment operation is observed. This section contains a troubleshooting chart, voltage and resistance measurement charts, a listing of the test equipment required, and a description of the test procedures to be followed during troubleshooting.

a. Test Equipment Required. - The following test equipment is required for troubleshooting the analyzer:

(1) Vacuum-tube-voltmeter (VTVM), RCA Voltohmyst or equivalent, for voltage and resistance measurements.

(2) Electron tube test set (tube tester) for checking vacuum tubes.

(3) Audio oscillator (oscillator), Hewlett-Packard Model 200CD or equivalent, for generating test signals.

(4) Oscilloscope, Tektronix Model 504B, or equivalent, for displaying test signals.

(5) Frequency Counter, Berkley/Beckman Model 554, or equivalent, for measuring frequencies.

b. Voltage and Resistance Measurement Tables. - Voltage and resistance measurement tables provide a means for circuit tracing and troubleshooting the equipment without disassembly. They may be used to isolate faulty parts in a given stage. Four tables are included, covering all tubes in the analyzer, under the different modes of operation.

(1) Voltage Measurements - Record Mode. - Using the VTVM, measure the voltage between the tube pins and ground (chassis, or test point TP1). Compare the measured value with the listing given in Table 6-10. Unless otherwise indicated, all values are volts dc. If the values differ by more than 10 percent, refer to the schematic diagrams to isolate possible faults. The measurements should be taken with the analyzer operated to record a 1000-cps test signal from the oscillator connected to MICROPHONE jack. Set the controls of the analyzer to the positions indicated below:

REC - REP Switch	REC
REC - REP LEVEL Control	-3 VU on the VU meter
BAND SELECTOR Switch	NARROW
FL-1 - HS - FL-2 Switch	FL-1
RECORD - OFF - REPROD. Lever	RECORD

Voltage at Tube Pins - Record Mode, Table 6-10

Tube	Pin 1	2	3	4	5	6	7	8	9
V1	*70 mvac	--	+1.8	--	6.3Vac	--	+118	+72.0	+1.8
V2	--	6.3Vac	+113	--	0.9Vac	--	--	+16.5	--
V3	0.6Vac	+205	+9.4	2.5Vac	+230	+3.2	6.3Vac	--	--
V4	*475 mvac	+250	+43	*370 mvac	+250	+43	6.3Vac	--	--
V5	30Vac	+240	+5.0	28Vac	+240	+5.0	6.3Vac	--	--
V301	--	+520	--	400Vac	--	400Vac	--	+520	--
V302	--	6.3Vac	+500	+500	+215	--	6.3Vac	+255	--
V303	--	6.3Vac	+500	+500	+215	--	6.3Vac	+255	--
V304	+170	+250	+175	+170	+215	+175	6.3Vac	6.3Vac	--
V305	--	--	--	--	+150	--	--	--	--
V306	-160	-159	+295	+150	+170	+150	6.3Vac	6.3Vac	--
V307	--	6.3Vac	--	-2.6	--	+125	6.3Vac	+295	--

*Value given is approximate, within 25 percent, and with MONITOR GAIN control set to 5.

(2) Voltage Measurements - Reproduce Mode. - Using the VTVM, measure the voltage between the tube pins and ground (chassis, or test point TP1). Compare the measured value with the listing given in Table 6-11. The measurements should be taken with a 1000-cps signal pre-recorded on the magnetic turntable, and the analyzer operated for preparing a spectrogram. When taking measurements of tubes V13, V14, and V15, position the stylus assembly on the lead-screw at 1 KC position, the leadscrew disengaged, and SECTIONER switch set to ON. To determine the 1-kc position of the stylus, make a chart which shows the upper and lower recording limits. Measure up from the lower limit 1/2 inch and mark this on the record. The stylus may now be moved to this position, which is the 1-kc point. Set the controls of the analyzer to the positions indicated in Table 6-11.

REC - REP Switch	REP
REC - REP LEVEL Control	-3 VU on the VU meter
BAND SELECTOR Switch	NARROW
SMALL DRUM - LARGE DRUM Switch	SMALL DRUM
FL-1 - HS- FL-2 Switch	FL-1
SECTIONER Switch	OFF, except when checking tubes V13, V14, V15
RECORD - OFF - REPROD. Lever	REPROD
MARK LEVEL Control	7.5
AGC Control (top of amplifier-analyzer chassis)	3.5

Voltage at Tube Pins - Reproduce Mode, Table 6-11

Tube	Pin 1	2	3	4	5	6	7	8
V3	100 mvac	+160	+6.2	800 mvac	+110	+3.1	6.3Vac	---
V6	120.Vac	+66	---	12.0Vac	+64	--	6.3Vac	---
V7	--	6.3Vac	+195	--	2.2Vac	--	--	+2.3
V10	--	6.3Vac	---	19 mvac	+590 mv	+39	--	+230
V11	--	6.3Vac	+1.35	350 mvac	+1.35	+54	--	+100
V12	--	6.3Vac	---	500 mvac	--	+38	--	+50
V13	--	+180	+2.3	--	+250	+2.3	--	6.3Vac
V14	-4.4	+180	---	-280 mv	+71	--	6.3Vac	---
V15	-31	+248	---	--	+248	--	6.3Vac	---
V16	--	6.3Vac	+230	+240	7.5Vac	--	--	+19.0
V17	4 mvac	+100	+650 mv	45 mvac	+37	--	6.3Vac	---
V18	--	--	---	1.0Vac	--	+85	6.3Vac	+200
V19	--	--	-560 mv	+2.0	-6.0	--	6.3Vac	-560 mv

(3) Resistance Measurements - Record Mode. - Using the ohmmeter scales of the VTVM, measure the resistance between the tube pins and ground (chassis, or test point TP1). Allow the reading to stabilize. Compare the measured value with the listing given in Table 6-12. If the values differ by more than 10 percent, refer to the schematic diagram to isolate possible faults. The measurements should be taken with all units interconnected, and all power sources disconnected. Set the controls of the analyzer to the positions indicated below:

ON - OFF Switch	OFF
MARK LEVEL Control	7.5
REC-REP LEVEL Control	Between 12 and 20
BAND SELECTOR Switch	NARROW
FL-1 - HS - FL-2 Switch	FL-1
REC - REP Switch	REC

Resistance at Tube Pins - Record Mode, Table 6-12

Tube	Pin 1	2	3	4	5	6	7	8	9
V1	3000	--	470	0	0	--	165K	100K	470
V2	--	--	130K	--	470K	--	0	10.5K	--
V3	390K	920K	9700	220K	72K	680	0	0	--
V4	490K	42K	4700	22K	42K	4700	0	0	--
V5	100K	Inf.	240	100K	Inf.	240	0	0	--
V301	--	330K	--	45	--	45	--	330K	--
V302	--	Inf.	390K	390K	750K	--	Inf.	43K	--
V303	--	Inf.	390K	390K	750K	--	Inf.	43K	--
V304	150K	43K	82K	50K	750K	82K	Inf.	Inf.	--
V305	--	0	--	--	54K	--	--	--	--
V306	100K	90K	1.2M	*58K	150K	54K	Inf.	Inf.	--
V307	0	Inf.	0	550K	0	36K	Inf.	1.1M	--

*Between 40K and 70K.

(4) Resistance Measurements - Reproduce Mode. - Using the ohmmeter scales of the VTVM, measure the resistance between the tube pins and ground (chassis, or test point TP1). Allow the reading to stabilize. Compare the measured value with the listing given in Table 6-13. If the two values differ by more than 10 percent, refer to the schematic diagram to isolate possible faults. The

measurements should be taken with all units interconnected, and all power sources disconnected. Set the controls of the analyzer to the positions indicated below:

ON - OFF Switch	OFF
MARK LEVEL Control	7.5
REC-REP LEVEL Control	Between 12 and 20
BAND SELECTOR Switch	NARROW
FL-1 - HS - FL-2 Switch	FL-1
REC - REP Switch	REC

Resistance at Tube Pins - Reproduce Mode, Table 6-13.

Tube	Pin 1	2	3	4	5	6	7	8
V3	33K	66K	3400	205K	46K	750	0	0
V6	490K	90K	0	480K	90K	0	0	0
V7	0	0	15.5K	--	180K	--	0	220
V10	0	0	0	220	270	500K	0	19K
V11	0	0	680	230	680	520K	0	115K
V12	0	0	0	310K	0	15K	0	120K
V13	1.6M	100K	140K	0	10K	140K	0	0
V14	800K	120K	0	770K	115K	0	0	0
V15	400K	100K	0	400K	100K	0	0	0
V16	0	0	11K	11K	220	--	0	500
V17	10K	135K	510	470K	1.2M	0	0	0
V18	0	0	0	520K	0	24K	0	36K
V19	0	0	Inf.	1500	250K	--	0	Inf.

c. Troubleshooting Procedure.

(1) In the troubleshooting chart, locate the symptom most nearly approximating the trouble encountered.

(2) Perform the test procedures indicated in the "Procedure" column of the troubleshooting chart.

(3) Compare the equipment performance with the requirements given in the "Performance Standard" column of the troubleshooting chart.

(4) When the equipment performance and the performance standard differ by more than 20 percent, check the components listed in the Remedy column of the troubleshooting chart.

(5) When vacuum tubes are listed in the Remedy column, the reference is to the tube and its associated circuit components. Therefore, first check the tube performance on the tube tester, and replace it if required; then check the voltage and resistance measurements at the tube pins in accordance with Tables 6-10 thru 6-13.

Troubleshooting Chart

Symptom	Procedure	Performance Standard	Remedy
Pilot lamp DS1 does not light, when ON-OFF switch is set to ON.	Measure a-c voltage at the following points:		
	J302	117V ac	Check power source and cables No. 9 and 10.
	J301-3 to J301-7	117V ac	Check fuse F301.
	J301-3 to J301-5	117V ac	Check switch S5, cable No. 2, and receptacle J4.
	J301-10 to J301-11	6V ac	Check transformer T302.
	J4-10 to J4-11	6V ac	Check cable No. 2 and receptacles J301 and Jr.
Turntable does not rotate or blower does not operate when RECORD - OFF-REPROD. lever is moved to RECORD or REPROD.	Measure a-c voltage at the following points:		
	J1-5 to J1-6	117V ac	Check switch S5.
	J203-5 to J203-6	117V ac	Check cable No. 1 and receptacles J1 and J203.
	J202	117V ac	Check blower B202, plug P202, receptacle J202, and switch S205.

Symptom	Procedure	Performance Standard	Remedy
	P201-4 to P201-1 or P201-2.	117V ac	Check motor B201, plug P201, receptacle J201, switch S205, and capacitor C202.
Buzzer does not sound when ON - OFF switch is set to OFF, and RECORD - OFF - REPROD. switch is not set to OFF.	Measure a-c voltage at the following points:		
	J1-6 to J1-7	117V ac	Check switch S5.
	J203-6 to J203-7.	117V ac	Check cable No. 1 and receptacles J1 and J203.
	Primary winding of transformer T201.	117V ac	Check switch S205.
	Secondary winding of transformer T201	3 to 8V ac	Check transformer T201, and buzzer DS202.
Click is not heard when RECORD - OFF - REPROD. lever is moved from OFF position.	Measure a-c voltage between the following points:		
	J203-5 to J203-6	117V ac	Check switch S205.
	Measure d-c voltage between the following points:		
	J10-4 to test point TP3.	-120V dc	Check relay K201.
Record-reproduce amplifier has low output or no output.	Measure d-c voltage between the following points:		
	J301-8 to J301-4	250V dc	Check setting of potentiometer R326; check tubes V301 through V306.
	J4-8 to J4-4	250V dc	Check cable No. 2 and receptacles J4 and J301.

Symptom	Procedure	Performance Standard	Remedy
	Perform test given in Section 6-1b.	250V dc in step (1), 6-1b.	Check tubes V301 through V306, transformer T301 chokes L301 & L302, cable No. 2, and receptacles J4 and J301.
		-115V dc in step (2).	Check tubes V306 & V307, transformer T303, cable No. 2, and receptacles J4 and J301.
Input signal is not recorded properly, and REC-REP LEVEL control has little or no effect.	Perform test given in Section 6-1c.	100 to 200 millivolts across resistor R202 in step (4), 6-1c.	Check tube V5, transformer T3, record-reproduce head PU201, resistor R202, cable No. 3, switches S2 and S6, receptacles J3 and J204, and relay K201.
		1.6 to 2.2 volts across resistor R203 in step (7).	Check tube V5, erase head PU202, resistor R203, cable No. 3 and receptacles J204 and J3.
	Perform test given in Section 6-1g.	As indicated in the procedure.	Check tubes V1 through V3. Make sure that no jumper exists between ground and J301-11 or J301-12 (filament line should not be grounded in power supply).
	Perform test given in Section 6-1h.	OVU ±1 VU, step 5 and 6; -2 VU ±1 in step 7.	Check capacitors C33 through C35, and C39, resistors R53 through R56, and R58, inductors L7 and L8, and switch S2.

Symptom	Procedure	Performance Standard	Remedy
	Perform tests given in paragraph 6-li.	0 VU on VU meter with REC-REP LEVEL control set between 16 and 20 in step (4), 6-li.	Check tubes V1 through V3, switches S2 and S9, transformer T2, and resistors R135 through R137.
		11 to 13 millivolts across R202 in step (5).	Check switch S2.
		-2 to -3 VU on VU meter in step (7).	Check capacitors C30, C31, C38, and C41, resistors R52 and R59, and switches S1 and S2.
		Measurements in this test are satisfactory, but VU meter indication is incorrect.	Check meter M1, resistors R61 and R62, and capacitor C43.
No audible signal is heard as MONITOR GAIN control is adjusted during recording or reproducing.	None	None	Check tube V4, transformer T5, receptacle J7, and loudspeaker.
Frequency scale on chart during reproducing is inaccurate.	Perform tests given in paragraph 6-lr.	1 volt between test points TP9 and TP1 in step (2).	Check tubes V6 and V7, switches S3, S4, S7, and S8, and resistors R65 and R201.
		Frequency variation from 35 kc to 61.7 kc in step (5)	Check settings of potentiometers R143, R144, and R148 through R151 and switches S3, S4, S7, and S8.
			Check resistor R201, potentiometers R143 and R144, switches S4, S7, and S8, cable No. 1 and receptacles J1 and J203.

Symptom	Procedure	Performance Standard	Remedy
	Perform test given in paragraph 6-1t.	Ohmmeter indication varies from 0 to 7000 ohms in step (3).	Check resistors R201, R143 and R144, switches S4, and S8, cable no. 1, and receptacles J1 and J203.
		Ohmmeter indication varies from 7000 to 0 ohms in step (4).	Check switch S8.
Pattern marking weak (light).	Perform test given in paragraph 6-1m.	Center frequency is 35.0 +0.2 kc with BAND SELECTOR switch set to NARROW, or 34.6 +0.4 kc in Wide in step (5).	Check filter Z1, diodes CR1 through CR4, inductors L4 and L5, resistor R128, capacitor C17, and switch S3.
		A minimum of 15 volts on ac voltmeter with BAND SELECTOR switch set to NARROW (step 6) or min 15V in WIDE, step(8).	Check tubes V10 V-11, V1w, V16, filter Z1, and switches S3 and S10.
		A minimum of 3 volts on ac voltmeter with BAND SELECTOR switch set to NARROW (step 4) or min 3 volts in WIDE step (8).	Check tubes V10, and V11; filter Z1, and switch S3.
		150 +50 cps bandwidth with BAND SELECTOR switch set to NARROW, or 1000 +300 cps in WIDE, in step (7).	Check filter Z1, switch S3, and resistors R33, R34, R127, and R128.
	Perform tests given in paragraph 6-1n.	35.0 +0.4 kc at less than 300 millivolts in step (4).	Check tubes V12 and V16, inductor L6, capacitor C26, transformer T4, cable No. 7, and receptacle J5.

Symptom	Procedure	Performance Standard	Remedy
		1150 ±300 cps bandwidth in step (7).	Check tubes V12 and V16, capacitor C26, and inductor L6.
		150V ac at stylus in step (8).	Check cable No. 7, receptacles J5 and J206, transformer T4, resistor R205, and indicator lamp DS201.
	Perform tests given in paragraph 6-10.	15V ac at TP2 in step (6).	Check tubes V10 through V16, filter Z1, and switch S4.
		35.0 ±0.4-kc center frequency in step (7).	Check inductors L5 and L6, capacitors C17, and C26, filter Z1, and switch S3.
	Perform tests given in paragraph 6-1p.	35-kc signal on oscilloscope in step (4).	Check resistor R201, potentiometers R143 and R144, switches S4,S7, and S8, cable No. 1, and receptacles J1 and J203.
Erratic marking during reproduction.	None	None	Check switches S2, and S10, stylus and stylus pressure, cable No. 7, and receptacles J5 and J206.
Poor trace definition on recording chart, and poor shading (no gradations in tone).	Perform test given in paragraph 6-1q.	Negative voltage indicated on VTVM in step (5).	Check tubes V10, V17, V18, and V19 and switches S3 and S4.
		VTVM indication and input signal level as given in step (6).	Check capacitor C74, resistor R27, and switch S3.
		VTVM indication and input signal level as given in step (7).	Check resistor R66, filter Z1, and switch S3.

Symptom	Procedure	Performance Standard	Remedy
Poor sectioner Performance.	Perform test given in paragraph 6-1u.	1 volt indicated on ac voltmeter in step (7).	Check tube V12, resistor R39, capacitors C23 and C73, switch S4, inductor L9, and diodes CR5 and CR6.
		6-8 millimeter line length on chart in step (11).	Check tubes V13, V14, and V15, switches S4 and S203, capacitors C73 and C201, diodes CR5 and CR6, cable No. 5, and receptacles J2 and J205.
		56 volts indicated on ac voltmeter in step (13).	Check tube V12, capacitors C23 and C73, resistor R39, switch S4, inductor L9, and diodes CR5 and CR6.
		41-43 millimeter line length on chart in step (14).	Check tubes V13, V14, and V15, switches S4 and S203, capacitors C73 and C201, inductor L9, and diodes CR5 and CR6, cable No. 5, and receptacles J2 and J205.

6-3 PREVENTIVE MAINTENANCE.

The preventive maintenance procedures given in this section should be performed according to a regular schedule to recognize changes in equipment performance, to anticipate parts failure, and to prevent serious equipment damage.

6-3A CLEANING.

(1) Remove ordinary dust and dirt from all exterior surfaces by wiping them clean, first with a clean cloth moistened with soapy water and then with a cloth wrung out in clean water. Wipe the surfaces dry with a clean, dry cloth.

(2) For obstinate dirt, grease, or other foreign matter, wipe the surfaces with dry-cleaning solvent.

(3) Clean accumulated dust and dirt from interior surfaces by blowing with a stream of clean, dry, low-pressure compressed air (5 psi). If compressed air is not available, wipe with dry-cleaning solvent.

(4) Clean electrical parts with trichloroethylene and dry with a clean, lint-free cloth.

CAUTION: Avoid getting trichlorethylene on knobs, plastic parts of switches, and the meter face. Trichloroethylene will dissolve thermoplastic materials.

(5) Clean record-reproduce and erase heads by wiping with alcohol.

(6) Clean drum surface with silver polish, and wipe away excess polish with a clean, dry cloth.

(7) Clean the pad, at the side of the turntable, with alcohol. Allow the pad to dry, replace it in its holder, and lubricate in accordance with paragraph 5, Section 6-3b.

6-3B LUBRICATION. - Lubricate the analyzer as indicated below:

(1) Monthly, apply one or two drops of machine lubricating oil, Grade 20 to door hinges or recorder slides, as applicable.

(2) Monthly, apply two to four drops of oil to the oil cups of the turntable drive motor.

(3) Semi-annually, apply two to four drops of machine lubricating oil, Grade 20, to the oil cups of the blower motor.

(4) Apply one or two drops of oil, monthly, to the threads of the leadscrew. Wipe away excess oil with a clean cotton cloth.

(5) Apply one or two drops of oil to the felt pad at the side of the turntable. The felt pad should be lubricated weekly, or after every 50 hours of operation.

(6) Monthly, apply a thin film of oil to the turntable spindle.

CAUTION: When removing the turntable and spindle, be careful not to nick the side walls of the bearing. Similarly, when replacing the turntable and spindle, align the spindle with the bearing and gently slide into place. Do not attempt to force the spindle.

6-3C MECHANICAL ADJUSTMENTS. - The following paragraphs describe the special adjustments required for maintaining the analyzer.

a. RECORD - OFF - REPROD. Lever Adjustment. - This adjustment is required when "wow" is indicated in turntable operation, or when drive wheels of the recorder are replaced.

(1) Back off the two socket-head setscrews in the grommet for RECORD - OFF - REPROD. lever.

(2) Set ON - OFF switch of the amplifier-analyzer to ON; the pilot lamp should glow. Allow the equipment to warm up for 15 minutes.

(3) Slowly slide RECORD - OFF - REPROD. lever toward RECORD until a click is heard. The click indicates the operation of the control relay. The blower motor should operate.

(4) Continue sliding RECORD - OFF - REPROD. lever toward RECORD until the turntable is engaged, and rotates freely. Do not move RECORD - OFF - REPROD. lever beyond the point of turntable engagement.

(5) Tighten socket-head setscrew on RECORD side of grommet, until it contacts RECORD - OFF - REPROD. lever.

(6) Repeat steps (3) through (5) with RECORD - OFF - REPROD. lever operated toward REPROD.

b. Record-Reproduce and Erase Head Pressure Adjustment.

(1) Check to see that RECORD - OFF - REPROD. lever is set to OFF.

(2) Adjust the bearing screws at the pivots for the head mounting arms to relieve all vertical play. Do not overtighten.

(3) Turn the ratchet of record-reproduce head (clockwise to increase pressure, counterclockwise to decrease pressure) until the head pressure against the turntable is approximately 30 grams. Use a spring balance to check the head pressure.

(4) Repeat step (3) for the erase head.

(5) Set RECORD - OFF - REPROD. lever to REPROD. The turntable should rotate. The record-reproduce and erase heads should contact the turntable and ride smoothly without bounce.

(6) Set RECORD - OFF - REPROD. lever to OFF. If necessary, repeat steps (2) through (5).

c. Sectioner Microswitch Adjustment.

(1) Place several knurled pins (equally spaced) in the holes at the top of the small drum.

(2) Rotate the microswitch control knob until the arm of the switch is retracted (away from the pins). No click should be heard at the switch when the turntable is rotated manually.

(3) Rotate the microswitch control knob until the arm of the switch is extended, then loosen the knurled nut of the sectioner assembly.

(4) Slowly rotate the turntable, and move the sectioner assembly toward the pins, until the switch is tripped each time a pin passes. Tighten the knurled nut, and adjust the setscrew on the underside of the assembly until it is bottomed against the stop nut.

(5) Check to see that the microswitch is tripped each time a knurled pin passes.

(6) Rotate the microswitch control knob to retract the arm of the switch. Check to see that the switch is not actuated as the knurled pins pass. If necessary, repeat steps (3) through (5).

SECTION VII
PARTS LISTS, SCHEMATICS

7-I IDENTIFICATION TABLE OF PARTS.

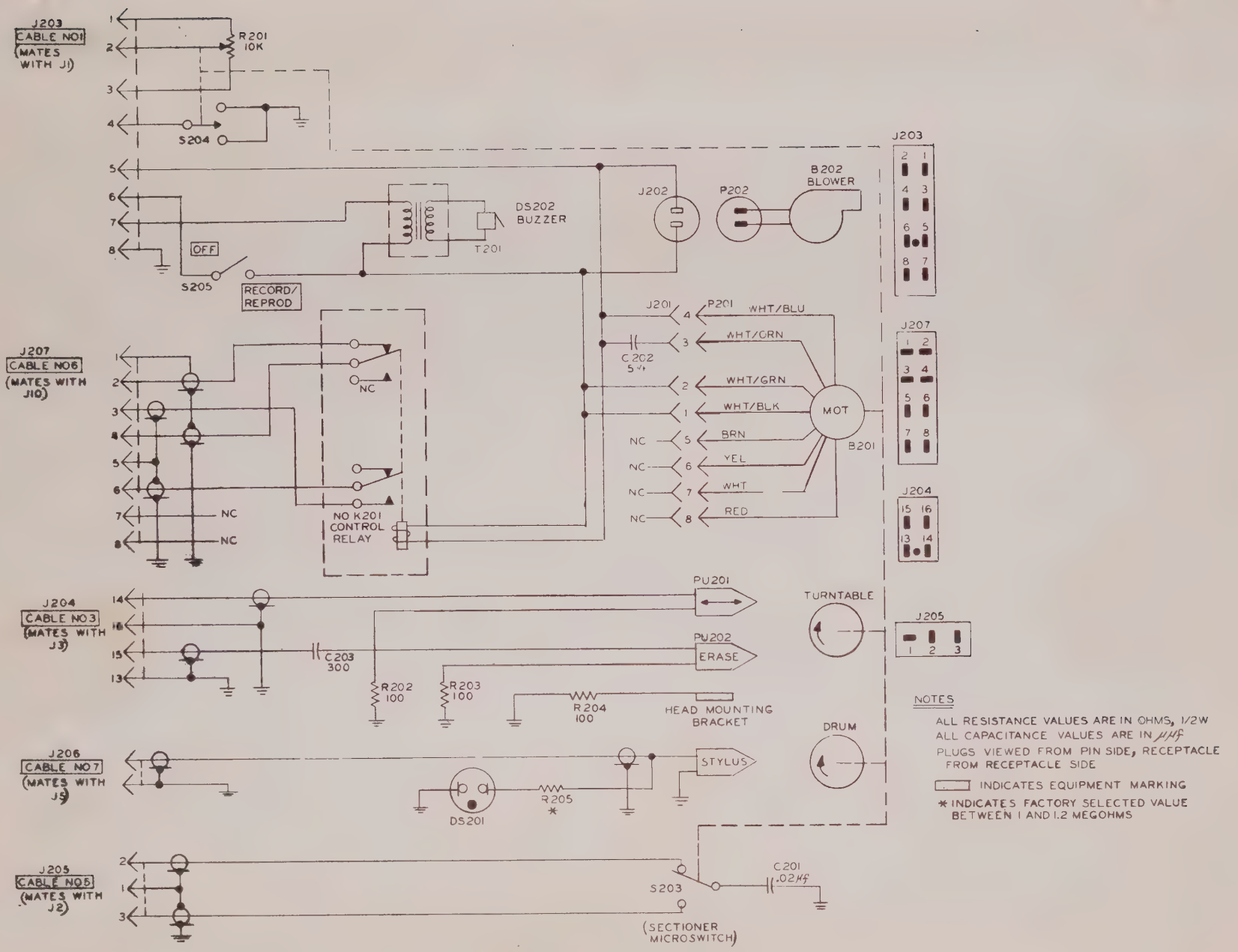
7-Ia Interconnecting Cables.

DWG. SYMBOL NO.	NAME OF PARTS AND DESCRIPTION	FUNCTION	KAY PART NO.
	Cable No. 1	Recorder power cable; J-1 to J-203 (8-prong)	1078
	Cable No. 2	Power supply cable; J-4 to J-301 (10-prong)	1079
	Cable No. 3	Record erase head cable; J-3 to J-204 (4-prong)	1076
	Cable No. 5	Sectioner microswitch cable; J-2 to J-205 (3-prong)	1077
	Cable No. 6	Control cable; J-10 to J-207 (8-prong miniature Jones)	7466
	Cable No. 7	Stylus cable; J-5 to J-206 (double ended BNC)	1075
	Cable No. 8	Large drum power cable; J-8 to J-303 (double ended Amphenol)	7410
	Cable No. 9	AC power cable; J-302 to source	7411
	Cable No. 10	Console power cable; J-302 to console cabinet	7412

7-Ib Recorder Unit, Schematic #C-7975-A.

B-201	Motor, alternating current: split phase; 117V AC; 50 cycles, 1800 rpm;	Turntable drive motor	904A-S
B-202	Fan, centrifugal: single phase; 117V AC; 3350 rpm	Remove smoke produced by stylus during graph marking	410
C-201	Capacitor, fixed, ceramic dielectric: 0.02 mf; 500 VDCW	Sectioner capacitor	6360-7
C-202	Capacitor, fixed, paper dielectric: 5 mf, 500V	B-201 phase shifter capacitor	906
C-203	Capacitor, fixed, mica dielectric: 300 mmf; 500 VDCW	Erase head coupling capacitor	6359-17
DS-201	Lamp, glow: NE2	Stylus indicator lamp	7144
DS-202	Buzzer: 3 to 8 volts	Turntable alarm power	951
J-201	Socket, electron tube: 8 pin; octal	B-201 power receptacle	921
J-202	Connector, receptacle, electrical: 2 pin	B-202 power receptacle	4111
J-203	Connector, receptable, electrical: 8 pin; large male contacts	Recorder power cable receptacle; cable no. 1	459
J-204	Connector, receptacle, electrical: 4 pin; large male contacts	Record-Erase head cable receptacle; cable no. 3	460
J-205	Connector, receptacle, electrical: 3 pin; small; male contacts	Sectioner cable receptacle; cable no. 5	461
J-206	Connector, receptacle, electrical: coaxial; type BNC	Stylus cable receptacle; cable no. 7	451

DWG. SYMBOL NO.	NAME OF PARTS AND DESCRIPTION	FUNCTION	KAY PART NO.
J-207	Connector, receptacle, electrical: 8 pin; small; male contacts	Control cable receptacle; cable no. 6	456
K-201	Relay, armature: DPDT; 6 amp, 115 volt coil; 15 amp contact rating	Control relay	915
P-201	Connector, plug, electrical: octal	B-201 power connecting plug	920
P-202	Connector, plug, electrical: 2 pin	B-202 power connecting plug	4112
PU-201	Head, sound recorder-reproducer	Records and reproduces on the magnetic drum	922
PU-202	Eraser, magnetic	Erases on the magnetic drum	923
R-201	Resistor, adjustable, wirewound: 10,000 ohms; 75 watt	Variable oscillator control resistor	911-A
R-202	Resistor, fixed, composition: carbon: 100 ohms; ½W	Record head coupling resistor	1011-E
R-203	Resistor, same as R-202	Erase head coupling resistor	
R-204	Resistor, same as R-202	Mounting bracket bleeder resistor	
R-205	Resistor, fixed, composition: 1.0 to 1.2 mego; factory selected value; 2W; carbon	DS-201 dropping resistor	
S-203	Switch, sensitive: SPDT;	Sectioner microswitch	901
S-204	Part of cover plate assembly		496A
S-205	Switch, sensitive: SPDT;	On-off control switch	7409
T-201	Transformer, power, step-down: 117 volts input; 6.3 volts output; 1.2 amperes output		952
	Bearing	Leadscrew bearing	593
	Belt, round	Drivebelt for leadscrew; 4 in. drum assembly	627
	Clamp Assembly	Stylus retainer and adjuster	587A
	Cover Plate Assembly	Stylus housing cover	496A
	Felt, 3/4 in. lg by 3/8 in wide by 1/4 in. high over-all dim.	Wiper for turntable	
	Filter, cartridge	To filter air drawn from stylus during marking	7021-7
	Follower	To engage half nut on leadscrew	500
	Gear, spur	Record and erase heads pressure adjust	598
	Half Nut	In stylus assembly	491
	Hose, coupling	Stylus exhaust filter hose	7436
	Insulator Assembly	Terminal board for connectors within stylus housing	557A
	Insulator, plate	Sliding contact assembly for R-201 and S-204	562A
	Leadscrew	To drive stylus during marking	605
	Pin, tapered	Sectioner microswitch tripping pin	938
	Plate, terminal: 5-5/16 in. lg by 1/2 in. wide by 1/4 in. high overall dimensions	Mounting plate for S-204 and R-201	497
	Plate Assembly	Cover for leadscrew drive on stylus housing	526A
	Pulley, flat: 3 in. OD by 29/32 in. ID	Record drive wheel from B-201 to turntable (24 rpm turntable speed)	588
	Pulley, flat: 2-3/8 in. OD by 3/8 ID	Reproduce drive wheel from B-201 to turntable (80 rpm turntable speed)	604



RECORDER, C-7975-A

DWG. SYMBOL NO.	NAME OF PARTS AND DESCRIPTION	FUNCTION	KAY PART NO.
	Race, inner	Used with outer race of bearing for speed control lever pivot	544
	Race, outer	Used with inner race of bearing for speed control lever pivot	545
	Roller	Speed shift lever detent	574
	Spring, garter, extension: 1/8 in. OD by 10 in. lg.	Paper retaining spring for 4 in. drum assembly	533
	Spring, helical, extension: 5/32 in. OD by 11/16 in. lg.	For insulator plate assembly 562A	534
	Terminal Board	Feed thru terminal board for record and erase heads connections	560A
	Tube, insulating	Marking stylus housing	579
	Turntable Assembly, with main bearing housing	Turntable and housing	607A
	Wire, stylus: 0.01 in. dia. by 1 in. lg.	For marking	407A

7-1c Amplifier-Analyzer Unit, Schematics D-7974-1A & D-7974-2A

C-1	Amplifier-Analyzer:	Records and reproduces audio spectrum signal and analyzes it for frequency, time, and amplitude characteristics	
C-1	Capacitor, fixed, electrolytic: 20-20 mf; 450 VDCW; dual	V-1 decoupling filter	6355-10
C-2	Capacitor, fixed, electrolytic: 25 mf; 25 VDCW	V-1 cathode bypass; XV1	6355-4
C-3	Capacitor;	Not used	
C-4	Capacitor, fixed, paper dielectric: 0.1 mf; 400 VDCW	V-1 output coupling; XV2	6899-2
C-5	Capacitor: same as C-1	V-2 decoupling;	
C-6	Capacitor, fixed, paper dielectric: 0.05 mf; 400 VDCW	V-2 output coupling; XV2	6899-6
C-7	Capacitor, fixed, ceramic dielectric: 175 mmf; 500 VDCW	R-138 bypass; XV2	6361-20
C-8	Capacitor: same as C-1	V-3 decoupling	
C-9	Capacitor, fixed, paper dielectric: 0.25 mf; 400 VDCW	V-3 output coupling; XV3	6899-3
C-10	Capacitor, fixed, ceramic dielectric: 0.02 mf; 500 VDCW	V-3 output coupling; XV3	6360-7
C-11	Capacitor: same as C-2	V-3 cathode bypass; XV3	
C-12	Capacitor, fixed, mica dielectric: 3300 to 5600 mmf; factory selected value; 500 VDCW	V-3 cathode filter; L-1 to ground	
C-13	Capacitor, fixed, ceramic dielectric: 100 to 150 mmf; factory selected value; 500 VDCW	V-3 audio output 35 kc filter; XV6 to L-3	
C-14	Capacitor, variable, mica dielectric: 7 to 45 mmf; 600 VDCW	V-3 audio output 35 kc filter; XV6 to L-3	6358-7
C-15	Capacitor: same as C-14	V-3 audio output 75 kc filter; L-2 to ground	
C-16	Capacitor: same as C-6	Modulator coupling; on terminal board	
C-17	Capacitor, fixed, mica dielectric: 0.01 mf; 300 VDCW	V-10 input filter; L-5 to ground	6359-41
C-18	Capacitor: same as C-1	V-10 Decoupling bypass	
C-19	Capacitor: fixed, electrolytic: 20 mf; 250 VDCW	V-11 Decoupling bypass; XV11 to XV12	6355-3

DWG. SYMBOL NO.	NAME OF PARTS AND DESCRIPTION	FUNCTION	KAY PART NO.
C-20	Capacitor, fixed, mica dielectric: 300 mmf; 500 VDCW	V-11 Output coupling; XV11	6359-17
C-21	Capacitor: same as C-2	V-11 Cathode bypass; XV11	
C-22	Capacitor, fixed, ceramic dielectric: 2000 mmf; 500 VDCW	V-12 AGC input bypass; S-4	6361-26
C-23	Capacitor: same as C-10	V-12 Output coupling; XV12	
C-24	Capacitor: same as C-10	V-12 Screen grid decoupling; XV12	
C-25	Capacitor, fixed, ceramic dielectric: 121 mmf; 500 VDCW	V-16 Input coupling; XV16	6361-18
C-26	Capacitor, fixed, mica dielectric: 800 to 900 mmf; factory selected value; 500 VDCW	V-16 Grid filter; XV16	
C-27	Capacitor: same as C-9	V-16 Cathode bypass; XV16	
C-28	Capacitor: same as C-4	V-16 Screen decoupling; XV16	
C-29	Capacitor, fixed, mica dielectric: 150 mmf; 500 VDCW	T-2 Output bypass; T-2	6359-10
C-30	Capacitor: same as C-20	Record equalization filter; S-2	
C-31	Capacitor: same as C-17	Reproduce equalization filter; S-2	
C-32	Capacitor: same as C-17	Reproduce equalization filter; L-8 to XV1	
C-33	Capacitor: same as C-13	Reproduce equalization filter; L-4 to L-7	
C-34	Capacitor: same as C-14	Reproduce equalization filter; L-4 to L-7	
C-35	Capacitor, fixed, mica dielectric: 3300 to 5000 mmf; factory selected value; 500 VDCW	Reproduce equalization filter; L-8 to ground	
C-36	Capacitor, fixed, mica dielectric: 62 to 82 mmf; factory selected value; 500 VDCW	Record bias coupling; T-3 to XV5	
C-37	Capacitor: same as C-14	Record bias coupling; T-3 to XV5	
C-38	Capacitor: same as C-17	Shaping filter; S-1	
C-39	Capacitor: same as C-17	V-2 Reproduce filter, XV2	
C-40	Capacitor, fixed, mica dielectric: 8200 mmf; 500 VDCW	Shaping filter, S-1	6359-40
C-41	Capacitor: same as C-17	Shaping filter; S-1	
C-42	Capacitor: same as C-29	Record signal coupling, terminal strip	
C-43	Capacitor: same as C-30	M-1 meter coupling; XV3	
C-44	Capacitor; fixed, mica dielectric: 400 mmf; 500 VDCW	V-7 Output; XV7	6359-21
C-45	Capacitor: same as C-4	V-7 Decoupling filter; XV7	
C-46	Capacitor: same as C-4	V-5 Decoupling filter; S-6 to ground	
C-47	Capacitor, fixed, mica dielectric: 2400 mmf; 500 VDCW	V-5 Bias oscillator tank capacitor; T-3	6359-42
C-48	Capacitor, fixed, mica dielectric: 91 mmf; 500 VDCW	V-5 Coupling; XV5	6359-6
C-49	Capacitor: same as C-48	V-5 Coupling; XV5	
C-50	Capacitor: same as C-17	V-4 Input coupling; XV4	
C-51	Capacitor: fixed, mica dielectric: 50 mmf; 500 VDCW	V-6 Coupling; XV6	6359-48
C-52	Capacitor: same as C-4	V-6 Decoupling filter; XV6	
C-53	Capacitor, fixed, ceramic dielectric: 10 mmf; 500 VDCW	V-6 Output coupling; XV6 to XV7	6361-7
C-54	Capacitor: same as C-51	V-6 Coupling; XV6	
C-55	Capacitor: same as C-9	V-6 Decoupling filter; XV6	

DWG. SYMBOL NO.	NAME OF PARTS AND DESCRIPTION	FUNCTION	KAY PART NO.
C-56	Capacitor: same as C-4	V-17 Decoupling filter; XV17	
C-57	Capacitor: same as C-4	V-17 Decoupling filter; XV17	
C-58	Capacitor, fixed, mica dielectric: 390 mmf; 500 VDCW	V-17 Coupling; XV17	6359-19
C-59	Capacitor: same as C-4	V-18 Decoupling filter; XV18	
C-60	Capacitor: same as C-58	V-18 Input coupling; XV18	
C-61	Capacitor: same as C-10	V-18 Cathode bypass; SV18	
C-62	Capacitor: same as C-4	V-18 Screen bypass; SV18	
C-63	Capacitor: same as C-22	V-19 Input coupling; XV19	
C-64	Capacitor: same as C-10	V-19 Output coupling; TP4	
C-65	Capacitor: same as C-17	V-13 Integrating network; XV13	
C-66	Capacitor: same as C-19	-120V DC filter; TJ-3 to ground	
C-67	Capacitor: same as C-4	V-14 Decoupling filter; XV14	
C-68	Capacitor: fixed, mica dielectric: 470 mmf; 500 VDCW	V-15 Output coupling; XV15	6359-23
C-69	Capacitor: same as C-51	V-15 Coupling; XV15	
C-70	Capacitor: same as C-4	V-15 Decoupling filter; XV15	
C-71	Capacitor: same as C-51	V-15 Coupling; XV15	
C-72	Capacitor, fixed, mica dielectric: 800 mmf; 500 VDCW	V-7 Output; XV7	6359-30
C-73	Capacitor, fixed, mica dielectric: 50 to 100 mmf; factory selected value; 500 VDCW	Sectioner coupling filter; XV13	
C-74	Capacitor, fixed, mica dielectric: 1000 mmf; 500 VDCW	Band Selector bypass; XV10	6359-32
C-75	Capacitor: same as C-17	V-18 Cathode bypass; XV18	
C-76	Capacitor, fixed, mica dielectric: 150 to 200 mmf; factory selected value; 500 VDCW	V-3 audio output 75 kc filter; L-2 to ground	
C-77	Capacitor: same as C-9	V-3 Output coupling; XV3-5 to R-139	
C-78	Capacitor, fixed, mica dielectric: 200 to 800 mmf; factory selected value; 500 VDCW	Modulator balancing; R-141 to ground	
CR-1	Diodes, 1N305; 4 matched diodes	Part of Modulator Assembly	6357-15M
CR-2	Diode, same as CR-1		
CR-3	Diode, same as CR-1		
CR-4	Diode, same as CR-1		
CR-5	Semiconductor Device, diode: 1N294	Sectioner coupling diode; XV13	6357-5
CR-6	Semiconductor Device: same as CR-5		
DS-1	Lamp, incandescent: bayonet base; #44	Power on indicator lamp	249
J-1	Connector, receptacle, electrical: 8 pin; female	Recorder power cable receptacle; cable no. 1	463
J-2	Connector, receptacle, electrical: 3 pin; female	Sectioner cable receptacle; cable no. 5	217
J-3	Connector, receptacle, electrical: 4 pin; female	Record-erase head cable receptacle; cable no. 3	478
J-4	Connector, receptacle, electrical: 10 pin; male	Power supply cable receptacle; cable no. 2	479
J-5	Connector, receptacle, electrical: BNC	Stylus cable receptacle; cable no. 7	451
J-6	Connector, receptacle, electrical: 3 circuit mike jack	Microphone input jack	1147
J-7	Connector, receptacle, electrical: 2 circuit mike jack; shorting	EXT Speaker output jack	4212

DWG. SYMBOL NO.	NAME OF PARTS AND DESCRIPTION	FUNCTION	KAY PART NO.
J-8	Connector, receptacle, electrical: shielded mike connector; male	Large drum power cable receptacle; cable no. 8	7513
J-9	Connector, receptacle, electrical: 6 pin; female	Amplitude display unit cable receptacle	474
J-10	Connector, receptacle, electrical: 8 pin; female	Control cable receptacle; cable no. 6	401
L-1	Coil, radio frequency: 6.5 mh; toroidal	V-3 Cathode bypass filter	1829
L-2	Coil, radio frequency: 20 mh; toroidal	V-3 Output 75 kc filter	1719
L-3	Coil, radio frequency: 100 mh; toroidal	V-3 Output 35 kc filter	1826
L-4	Coil, radio frequency: 500 mh; toroidal	Modulator output filter	1723
L-5	Coil, radio frequency: 2 mh; toroidal	V-10 35 kc input filter	1721-R
L-6	Coil: same as L-2	V-16 Cathode filter	
L-7	Coil: same as L-3	Reproduce equalization filter	
L-8	Coil, radio frequency: 10 mh; toroidal	Reproduce equalization filter	7200
L-9	Coil: same as L-3	Sectioner coupling filter	
M-1	Meter, audio level	Record-reproduce amplifier output level indicator	1431
R-1	Resistor, fixed, composition: 10,000 ohms, ½ W; carbon	V-1 Plate supply decoupling filter; XV1	1031-E
R-2	Resistor, fixed, composition: 47,000 ohms, 1 W; carbon	V-1 Plate load resistor; XV1	4731-G
R-3	Resistor, fixed, composition: 120,000 ohms; 1 W; carbon	V-1 Screen grid coupling; XV1	1241-G
R-4	Resistor, fixed, composition: 220 ohms; ½ W; carbon	V-1 Screen suppressor: XV1	2211-E
R-5	Resistor, fixed, composition: 470 ohms; ½ W; carbon	V-1 Cathode; XV1	4711-E
R-6	Resistor; same as R-4	V-1 Output coupling; XV1	
R-7	Resistor, fixed, composition: 470,000 ohms; ½ W; carbon	V-2 Grid leak; XV2	4741-E
R-8	Resistor, fixed, composition: 7500 ohms; ½ W; carbon	V-2 Feedback; XV2	7225-E
R-9	Resistor, fixed, composition: 33,000 ohms; 1 W; carbon	V-2 Decoupling filter; XV2	3331-G
R-10	Resistor: same as R-2	V-2 Plate load; XV2	
R-11	Resistor: same as R-4	V-2 Output coupling; XV2	
R-12	Resistor, fixed, composition: 3000 ohms; ½ W; carbon	V-2 Cathode resistor; XV2	3025-E
R-13	Resistor: same as R-4	V-3 input coupling; XV3	
R-14	Resistor, fixed, composition: 1 mego; 1/2 W; carbon	V-3 Grid leak; XV3	1051-E
R-15	Resistor, fixed, composition: 2200 ohms; ½ W; carbon	V-3 Cathode resistor; XV3	2221-E
R-16	Resistor: same as R-8	V-3 Cathode resistor; XV3	
R-17	Resistor, fixed, composition: 18,000 ohms; ½ W, carbon	V-3 Decoupling filter; XV3	1831-E
R-18	Resistor: same as R-9	V-3 Plate load; XV3	
R-19	Resistor, fixed, composition: 4700 ohms, ½ W, carbon	V-3 Decoupling filter; XV3	4721-E
R-20	Resistor, fixed, composition: 27,000 ohms; 1 W; carbon	V-3 Plate load; XV3	2731-E
R-21	Resistor: same as R-7	V-3 Grid leak; XV3	

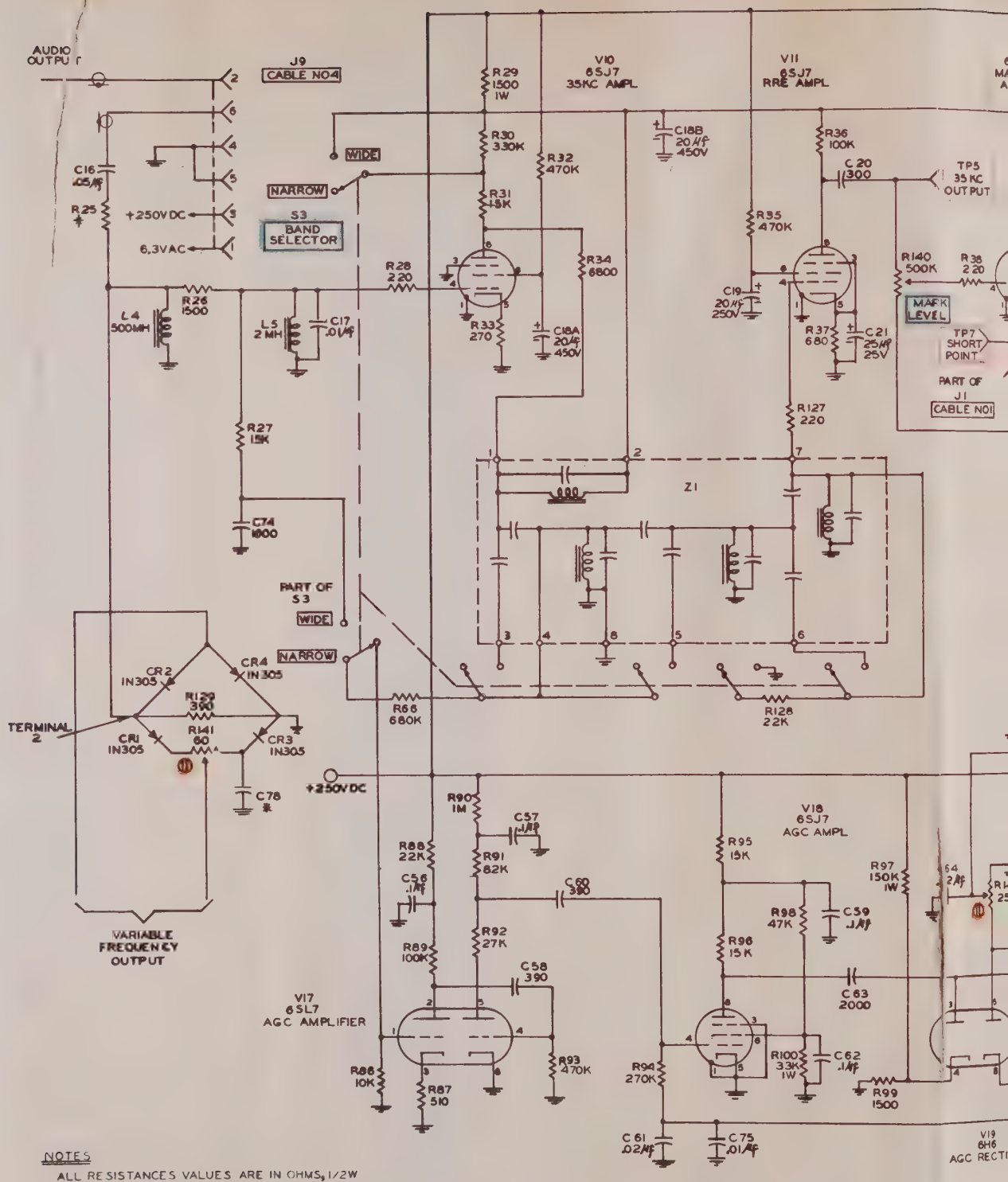
DWG. SYMBOL NO.	NAME OF PARTS AND DESCRIPTION	FUNCTION	KAY PART NO.
R-22	Resistor, fixed, composition: 680 ohms; ½ W; carbon	V-3 Cathode resistor; XV3	6811-E
R-23	Resistor, fixed, composition: 180,000 ohms; ½ W; carbon	Audio output attenuator; terminal board	1841-E
R-24	Resistor, fixed, composition: 20,000 ohms; ½ W; carbon	Audio output attenuator; terminal board	2035-E
R-25	Resistor, fixed, composition: 18,000 to 27,000 ohms; factory selected value; ½ W, carbon	Modulator coupling; terminal board	
R-26	Resistor, fixed composition: 1500 ohms; ½ W; carbon	Modulator output coupling; Modulator assembly to L-5	1521-E
R-27	Resistor, fixed, composition: 15,000 ohms; ½ W; carbon	AGC Input coupling; XV10	1531-E
R-28	Resistor: same as R-4	V-10 Input coupling; XV10	
R-29	Resistor, fixed, composition: 1500 ohms; 1 W; carbon	V-10 Plate supply decoupling resistor; XV10	1521-G
R-30	Resistor, fixed, composition: 330,000 ohms; ½ W; carbon	V-10 Plate load; XV10	3341-E
R-31	Resistor: same as R-27	V-10 Plate load; XV10	
R-32	Resistor: same as R-7	V-10 Screen grid coupling; XV10	
R-33	Resistor, fixed, composition: 270 ohms; ½ W; carbon	V-10 Cathode resistor; XV10	2711-E
R-34	Resistor, fixed, composition: 6800 ohms; ½ W; carbon	V-10 Output coupling; XV10	6821-E
R-35	Resistor: same as R-7	V-11 Screen grid coupling; XV12	
R-36	Resistor, fixed, composition: 100,000 ohms; ½ W; carbon	V-11 Plate load resistors; XV11	1041-E
R-37	Resistor: same as R-22	V-11 Cathode resistor; XV11	
R-38	Resistor: same as R-4	V-12 Input coupling resistor; XV12	
R-39	Resistor: same as R-4	V-12 Output coupling resistor; XV12	
R-40	Resistor: same as R-36	V-12 Plate load; XV12	
R-41	Resistor, fixed, composition: 82,000 ohms; 1 W; carbon	V-12 Screen grid coupling; XV12	8231-G
R-42	Resistor: same as R-4	V-16 Grid coupling; XV16	
R-43	Resistor: same as R-27	V-12 Output coupling; XV12	
R-44	Resistor, fixed, wirewound: 500 ohms; 5 W	V-16 Cathode resistor; XV16	5015-J
R-45	Resistor: same as R-4	V-16 Plate load; XV16	
R-46	Resistor: same as R-4	V-16 Screen grid coupling; XV16	
R-47	Resistor, fixed, composition: 47,000 ohms; 2 W, carbon	T-4 Output load; XV16	4731-H
R-48	Resistor, fixed, composition: 360 ohms; ±5%; 2 W; carbon	V-16 Plate supply decoupling; XV16	3615-H
R-49	Resistor, fixed, composition: 270,000 ohms; ½ W; carbon	Stylus output attenuator; J-5 to TP2	2741-E
R-50	Resistor, fixed, composition: 30,000 ohms; ½ W; carbon	Stylus output attenuator; TP2 to ground	3035-E
R-51	Resistor: same as R-48	V-5 Plate supply decoupling; XV5	
R-52	Resistor, fixed, composition: 120,000 ohms; ½ W; carbon	Record equalization filter; S-2	1241-E
R-53	Resistor, fixed, composition: 4700 to 5600 ohms; factory selected value; ½ W; carbon	Reproduce equalization filter; XV1	
R-54	Resistor: same as R-1	Reproduce equalization filter; L-8 to ground	
R-55	Resistor: same as R-12	Reproduce equalization filter; XV2	

DWG. SYMBOL NO.	NAME OF PARTS AND DESCRIPTION	FUNCTION	KAY PART NO.
R-56	Resistor: same as R-5	Reproduce equalization filter; XV2	
R-57	Resistor: same as R-22	Shaping filter; S-1 to ground	
R-58	Resistor: same as R-26	Reproduce equalization filter; S-2 to ground	
R-59	Resistor, fixed, composition: 47,000 ohms; ½ W; carbon	V-3 Audio output coupling; XV3	4731-E
R-60	Resistor: same as R-59	V-3 audio output coupling; terminal board	
R-61	Resistor: same as R-27	M-1 Meter coupling; XV3	
R-62	Resistor, fixed, composition: 22,000 to 33,000 ohms; factory selected value; ½ W; carbon	M-1 Meter coupling; XV3	
R-63	Resistor: same as R-27	V-7 Plate load; XV7	
R-64	Resistor: same as R-19	V-7 Plate supply decoupling; XV7	
R-65	Resistor: same as R-7	AGC Input coupling; XV4	
R-66	Resistor, fixed, composition: 680,000 ohms; ½ W; carbon	AGC Input couplirg; S-3	6841-E
R-67	Resistor, fixed, composition: 3300 ohms: ½ W; carbon	V-5 Coupling; XV5	3321-E
R-68	Resistor: same as R-67	V-5 Coupling; XV5	
R-69	Resistor, fixed, composition: 240 ohms; ±5%; 1 W; carbon	V-5 Cathode: XV5	2415-G
R-70	Resistor: same as R-36	V-5 Grid leak; XV5	
R-71	Resistor: same as R-36	V-5 Grid leak; XV5	
R-72	Resistor: same as R-69	V-5 Cathode resistor; XV5	
R-73	Resistor: same as R-7	V-4 Grid leak; XV4	
R-74	Resistor, fixed, composition: 22,000 ohms; ½ W; carbon	V-4 Feedback resistor; XV4	2231-E
R-75	Resistor, fixed, composition: 4700 ohms; 1 W; carbon	V-4 Cathode resistor; XV4	4721-G
R-76	Resistor, fixed, composition: 150,000 ohms; ½ W; carbon	V-4 Feedback coupling; XV4	1541-E
R-77	Resistor, fixed, film: 470,000 ohms; ¼ W	V-6 Grid leak; XV6	6558-90
R-78	Resistor, fixed, composition: 39,000 ohms; ±5%; 2W; carbon	V-6 Plate supply decoupling; XV6	3931-H
R-79	Resistor: same as R-78	V-6 Plate load; XV6	
R-80	Resistor; same as R-78	V-6 Plate load; XV6	
R-81	Resistor: same as R-7	V-6 Output coupling; XV7	
R-82	Resistor: same as R-77	V-6 Grid leak; XV6	
R-83	Resistor: same as R-23	V-7 Grid leak; XV7	
R-84	Resistor: same as R-4	V-7 Plate load; XV7	
R-85	Resistor: same as R-4	V-7 Cathode resistor; XV7	
R-86	Resistor: same as R-1	V-17 Grid leak; XV17	
R-87	Resistor, fixed, composition: 510 ohms; ±5%; ½ W; carbon	V-17 Cathode resistor; XV17	5115-E
R-88	Resistor: same as R-74	V-17 Plate supply decoupling; XV17	
R-89	Resistor: same as R-36	V-17 Plate load; XV17	
R-90	Resistor: same as R-14	V-17 Plate supply decoupling; XV17	
R-91	Resistor, fixed, composition: 82,000 ohms; ½ W; carbon	V-17 Plate load; XV17	8231-E
R-92	Resistor, fixed, composition: 27,000 ohms; ½ W; carbon	V-17 Plate load; XV17	2731-E
R-93	Resistor: same as R-7	V-17 Grid leak; XV17	

DWG. SYMBOL NO.	NAME OF PARTS AND DESCRIPTION	FUNCTION	KAY PART NO.
R-94	Resistor: same as R-49	V-18 Grid leak; XV18	
R-95	Resistor: same as R-27	V-18 Plate supply decoupling; XV18	
R-96	Resistor: same as R-27	V-18 Plate load; XV18	
R-97	Resistor, fixed, composition: 150,000 ohms; 1 W; carbon	V-19 Cathode voltage divider; XV19	1541-G
R-98	Resistor: same as R-59	V-18 Screen grid coupling; XV18	
R-99	Resistor: same as R-26	V-19 Cathode voltage divider; XV19	
R-100	Resistor: same as R-9	V-18 Screen load; XV18	
R-101	Resistor: same as R-67	-120V DC voltage divider; S-4 to ground	
R-102	Resistor: same as R-52	-120V DC voltage divider; -120V DC buss to S-4	
R-103	Resistor, fixed, composition: 33 ohms; ½ W; carbon	Sectioner input coupling; XV13	3301-E
R-104	Resistor, fixed, composition: 1.2 to 1.5 mego; factory selected value; ±5%; ½ W; carbon	Integrating resistor; XV13	
R-105	Resistor: same as R-36	V-13 Plate load; XV13	
R-106	Resistor, fixed, composition: 560,000 ohms; ½ W; carbon	V-13 Output coupling; XV13	5641-E
R-107	Resistor: same as R-91	Sectioner input load; XV13	
R-108	Resistor, fixed, composition: 62,000 ohms; ±5%; ½ W; carbon	V-13 Cathode resistor; XV13 to -120V DC buss	6235-E
R-109	Resistor, fixed, composition: 430,000 ohms; ±5%; ½ W; carbon	V-13 Output coupling; -120V DC buss to R-146	4345-E
R-110	Resistor, fixed, composition: 560,000 ohms; ½ W; carbon	V-14 Grid coupling; XV14	5641-E
R-111	Resistor, fixed, composition: 5.6 mego; ½ W; carbon	V-14 Grid leak; XV14	5651-E
R-112	Resistor, fixed, composition: 220,000 ohms; ½ W; carbon	V-14 Grid leak; XV14	2241-E
R-113	Resistor, fixed, composition: 39,000 ohms; ½ W; carbon	V-14 Plate supply decoupling; XV14	3931-E
R-114	Resistor: same as R-91	V-14 Plate load; XV14	
R-115	Resistor: same as R-91	V-14 Plate load; XV14	
R-116	Resistor, fixed, composition: 1.2 mego; ½ W; carbon	V-14 Plate coupling; XV14	1251-E
R-117	Resistor: same as R-36	V-14 Grid coupling; XV14	
R-118	Resistor, fixed, composition: 2.2 mego; ½ W; carbon	V-14 Feedback; XV14	2251-E
R-119	Resistor: same as R-7	V-14 Output coupling; XV14	
R-120	Resistor: same as R-116	V-14 Grid bias coupling; XV14	
R-121	Resistor: same as R-36	V-15 Grid leak; XV15	
R-122	Resistor, fixed, composition: 330,000 to 470,000 ohms; factory selected value; ±5%; ½ W; carbon	V-15 Grid bias coupling; XV14	
R-123	Resistor: same as R-113	V-15 Plate supply decoupling; XV15	
R-124	Resistor: same as R-59	V-15 Plate load; XV15	
R-125	Resistor: same as R-59	V-15 Plate load; XV15	
R-126	Resistor: same as R-36	V-15 Grid leak; XV15	
R-127	Resistor: same as R-4	V-11 Input coupling; XV11	
R-128	Resistor: same as R-74	Z-1 Load resistor; XV11	
R-129	Resistor, fixed, composition: 390 ohms; ½ W; carbon	Modulator load; on modulator assembly	3911-E

DWG. SYMBOL NO.	NAME OF PARTS AND DESCRIPTION	FUNCTION	KAY PART NO.
R-130	Resistor, fixed, composition: 15,000 ohms; 1W; carbon	Sectioner output load; S-4 to ground	1531-G
R-131	Resistor: same as R-74	Reproduce equalization filter; S-1	
R-132	Resistor, fixed, composition: 330,000 ohms; 2 W; carbon	Audio output voltage divider; terminal strip on divider panel	3341-H
R-133	Resistor, fixed, composition: 1 meg; 2 W	Audio output voltage divider; terminal strip on divider panel	1051-H
R-134	Not used		
R-135	Resistor, fixed, composition: 47 ohms; 1 W; carbon	Input attenuator; S-9	4701-G
R-136	Resistor: same as R-130	Input attenuator; S-9	
R-137	Resistor: same as R-130	Input attenuator; S-9	
R-138	Attenuator, variable: 250,000 ohms; 2 db per step	REC-REP LEVEL control	488WS
R-139	Resistor, variable: 500,000 ohms; 2 W	MONITOR GAIN control	127
R-140	Resistor: same as R-139	MARK LEVEL control	
R-141	Resistor, variable: 60 ohms; 2 W	Modulator balancing resistor; chassis	88-1A
R-142	Attenuator: same as R-138	AGC level; chassis	
R-143	Resistor, variable: 10,000 ohms; 2 W; linear	85~/4KC range adjust; chassis	108
R-144	Resistor, variable: 10,000 ohms; 2 W; linear; dual	85~/4KC range adjust; chassis	110
R-145	Resistor: same as R-139	Long pulse adjust; chassis	
R-146	Attenuator: same as R-138	Short pulse adjust; chassis	
R-147	Resistor, variable: 1 mego; 2 W	Sectioner output level adjust; chassis	130
R-148	Resistor, variable: 25,000 ohms; 2 W	Normal range adjust; chassis	113
R-149	Resistor, variable: 25,000 ohms; 2 W; linear; dual	Normal range adjust; chassis	7517
R-150	Resistor: same as R-148	4KC/8KC range adjust; chassis	
R-151	Resistor: same as R-149	4KC/8KC range adjust; chassis	
S-1	Switch, rotary; 1 wafer; 3 position; 30° indexing	FL-1 - HS - FL-2 Shaping filter; front panel	446
S-2	Switch, rotary; 2 wafer; 2 position; 30° indexing	REC - REP switch; front panel	443
S-3	Switch, rotary; 2 wafer; 2 position; 30° indexing	BAND SELECTOR switch; front panel	445
S-4	Switch: same as S-3	SECTIONER switch; front panel	
S-5	Switch, toggle: DPDT	ON - OFF switch; front panel	254-A
S-6	Switch, toggle: SPDT	B+ OFF switch; chassis	256-A
S-7	Switch: same as S-1	FREQ SPREAD switch; front panel	
S-8	Switch; same as S-5	INVERT BURN - FREQ NORMAL switch; front panel	
S-9	Switch: same as S-5	LINE - MIKE switch; front panel	
S-10	Switch: same as S-6	SMALL DRUM - LARGE DRUM switch; front panel	
T-1	transformer, radio frequency: 7 mh	Variable oscillator; amplifier output coupling	1825
T-2	Transformer, audio frequency: matching	Audio input transformer	1001
T-3	Transformer, radio frequency: 0.5-5-0.5 mh	Bias-erase oscillator transformer	1828
T-4	Transformer, radio frequency: 17-34 mh	Power amplifier output	1726

DWG. SYMBOL NO.	NAME OF PARTS AND DESCRIPTION	FUNCTION	KAY PART NO.
T-5	Transformer, audio frequency:	Monitor amplifier output	1002
TP-1	Jack, tip: banana type; black	Ground test jack; rear panel	448
TP-2	Jack, tip: banana type; red	Stylus output test jack; rear panel	447
TP-3	Jack: same as TP-2	-120V DC test jack; rear panel	
TP-4	Jack: same as TP-2	AGC output test jack; rear panel	
TP-5	Jack: same as TP-2	Marker amplifier input test jack; rear panel	
TP-6	Jack: same as TP-2	+250V DC test jack; rear panel	
TP-7	Jack: same as TP-2	Marker amplifier bias test jack; rear panel	
TP-8	Jack: same as TP-2	Variable oscillator bias test jack; rear panel	
TP-9	Jack: same as TP-2	Variable oscillator output test jack; rear panel	
TP-10	Jack: same as TP-2	Audio output test jack; rear panel	
V-1	Electron Tube: Type 5879	Record-reproduce amplifier	5879
V-2	Electron Tube: Type 6J5	Record-reproduce amplifier	6J5
V-3	Electron Tube: Type 6SN7	Record-reproduce amplifier	6SN7
V-4	Electron Tube: same as V-3	Monitor amplifier	
V-5	Electron Tube: Type 6BL7	Bias-erase oscillator	6BL7
V-6	Electron Tube: same as V-3	Variable oscillator	
V-7	Electron Tube: same as V-2	Variable oscillator buffer amplifier	
V-8	Not used		
V-9	Not used		
V-10	Electron Tube: Type 6SJ7	35 KC amplifier	6SJ7
V-11	Electron Tube: same as V-10	Pre-amplifier	
V-12	Electron Tube: Type 6SK7	Marker amplifier	6SK7
V-13	Electron Tube: Type 6SL7	Trigger pulse amplifier	6SL7
V-14	Electron Tube: same as V-13	DC amplifier	
V-15	Electron Tube: same as V-3	Sectioner multivibrator	
V-16	Electron Tube: Type 6L6	Power amplifier	6L6
V-17	Electron Tube: same as V-13	AGC amplifier	
V-18	Electron Tube: same as V-10	AGC amplifier	
V-19	Electron Tube: Type 6H6	AGC rectifier	6H6
XV-1	Socket, electron tube: 9 pin; Vector	Socket for V-1	6409
XV-2	Socket, electron tube: octal; Vector	Socket for V-2	437
XV-3	Socket: same as XV2	Socket for V-3	
XV-4	Socket, electron tube: Vector	Socket for V-4	438
XV-5	Socket: same as XV2	Socket for V-5	
XV-6	Socket: same as XV2	Socket for V-6	
XV-7	Socket: same as XV2	Socket for V-7	
XV-8	Not used		
XV-9	Not used		
XV-10	Socket: same as XV4	Socket for V-10	
XV-11	Socket: same as XV2	Socket for V-11	
XV-12	Socket: same as XV4	Socket for V-12	
XV-13	Socket: same as XV2	Socket for V-13	
XV-14	Socket: same as XV2	Socket for V-14	
XV-15	Socket: same as XV2	Socket for V-15	



NOTES

ALL RESISTANCES VALUES ARE IN OHMS, 1/2W UNLESS INDICATED OTHERWISE

ALL CAPACITANCE VALUES ARE IN μμf 500 VDCW UNLESS INDICATED OTHERWISE

PLUG VIEWED FROM PIN SIDE, RECEPTACLES FROM RECEPTACLE SIDE

JUMPER BETWEEN PINS 2 AND 6 OF J9 EXCEPT WHEN AMPLITUDE DISPLAY UNIT IS USED

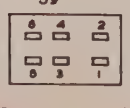
Ⓜ INDICATES SCREWDRIVER ADJUSTED CONTROLS

▭ INDICATES EQUIPMENT MARKINGS

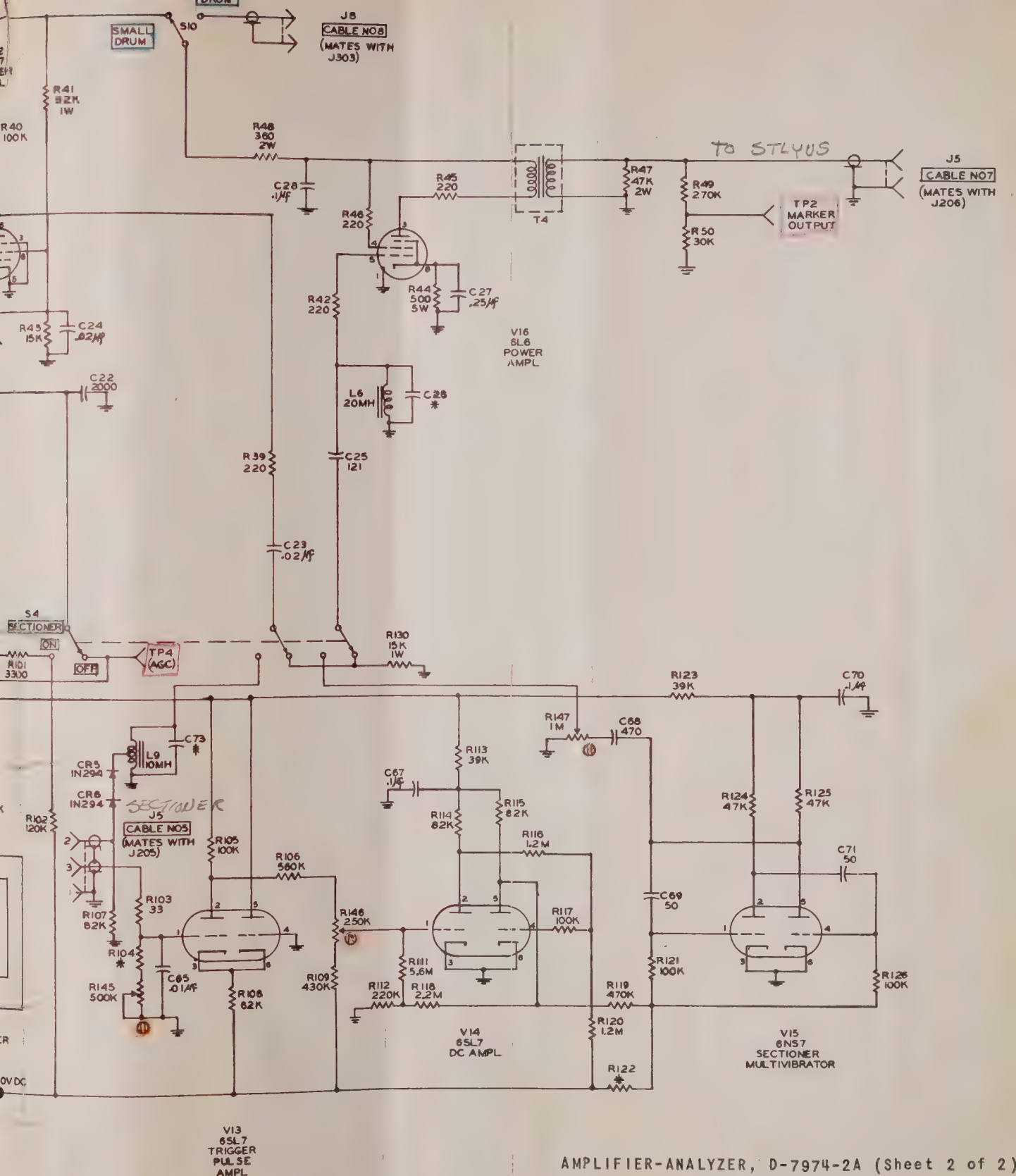
* INDICATES FACTORY SELECTED VALUES AS FOLLOWS:

C 26 800-900 μμf
C 73 50-100 μμf
C 78 200-800 μμf
R 25 18K-27K
R 104 1.2M-1.5M
R 122 330K-470K

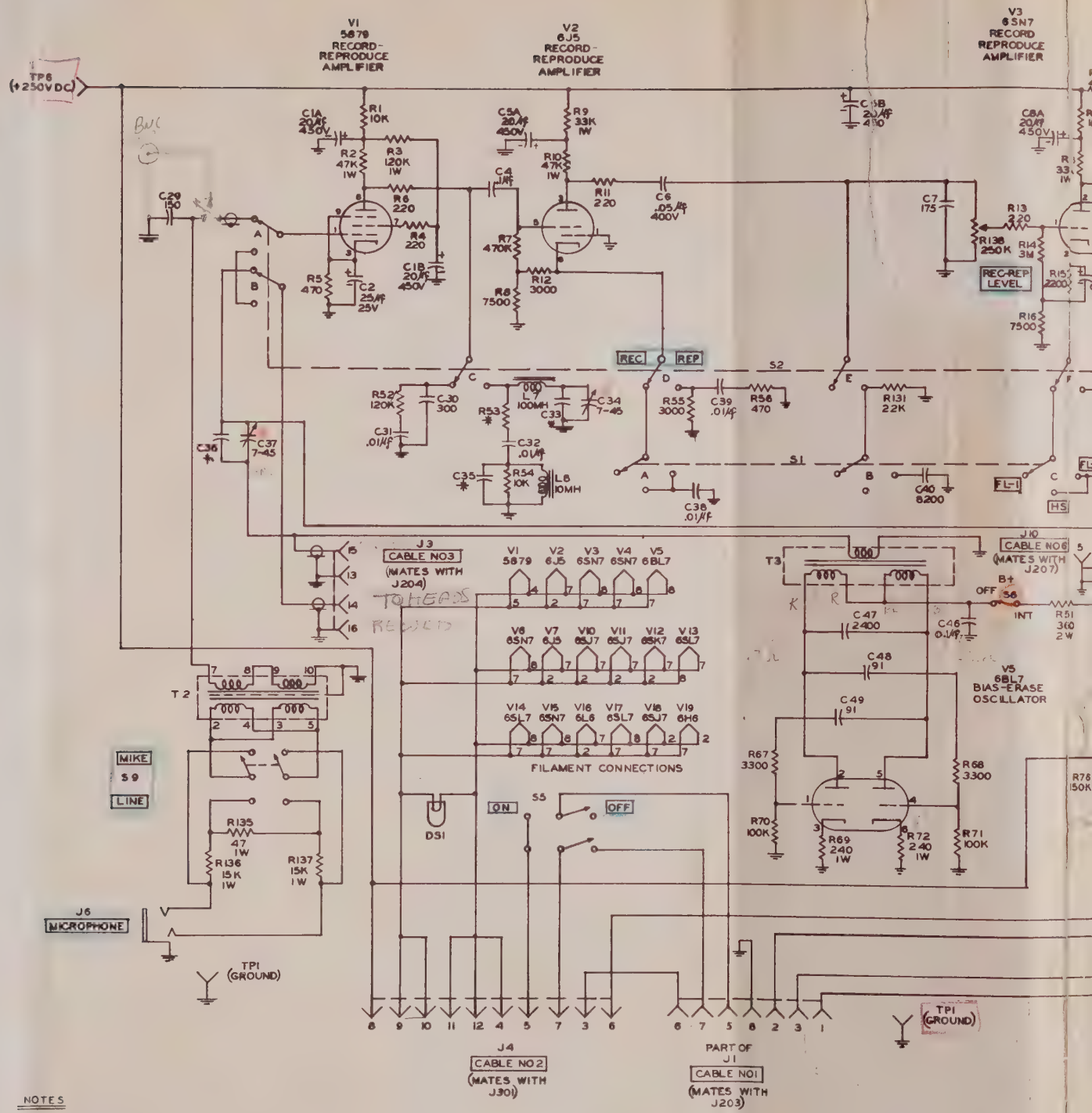
J9



RED = T.P.
BLUE = FRONT



AMPLIFIER-ANALYZER, D-7974-2A (Sheet 2 of 2)



NOTES

ALL RESISTANCES VALUES ARE IN OHMS, 1/2W UNLESS INDICATED OTHERWISE

ALL CAPACITANCE VALUES ARE IN $\mu\mu F$ 500V DCW UNLESS INDICATED OTHERWISE

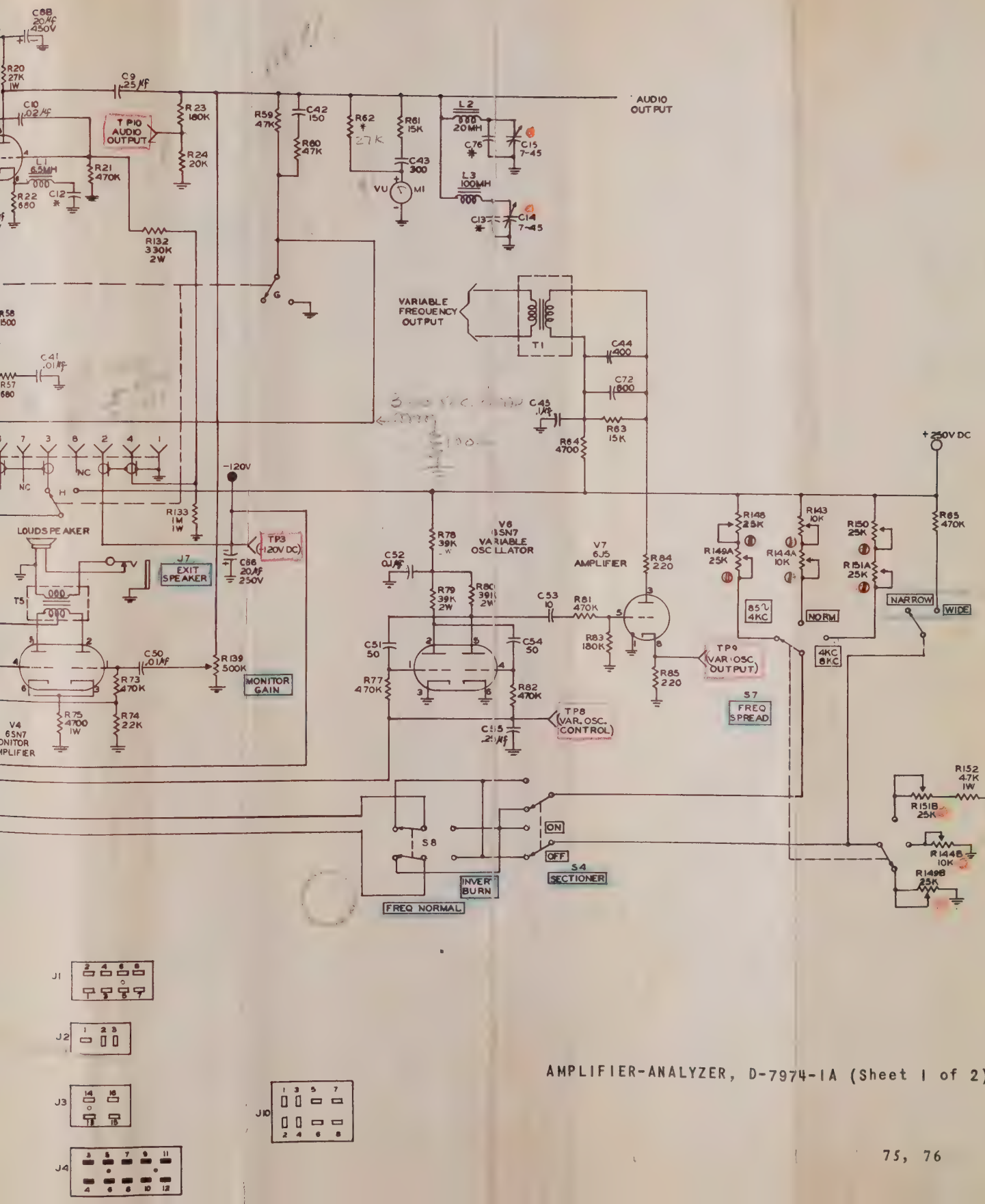
Ⓓ INDICATES SCREWDRIVER ADJUSTED CONTROLS

▭ INDICATES EQUIPMENT MARKING

PLUG VIEWED FROM PIN SIDE, RECEPTACLES FROM RECEPTACLE SIDE

* INDICATE FACTORY SELECTED VALUES AS FOLLOWS:

C12 3300-5600 $\mu\mu F$
C13 & C33 100-150 $\mu\mu F$
C35 3300-5000 $\mu\mu F$
C36 62-82 $\mu\mu F$
C76 150-200 $\mu\mu F$
R53 4700-5600
R62 22K-33K



AMPLIFIER-ANALYZER, D-7974-1A (Sheet 1 of 2)

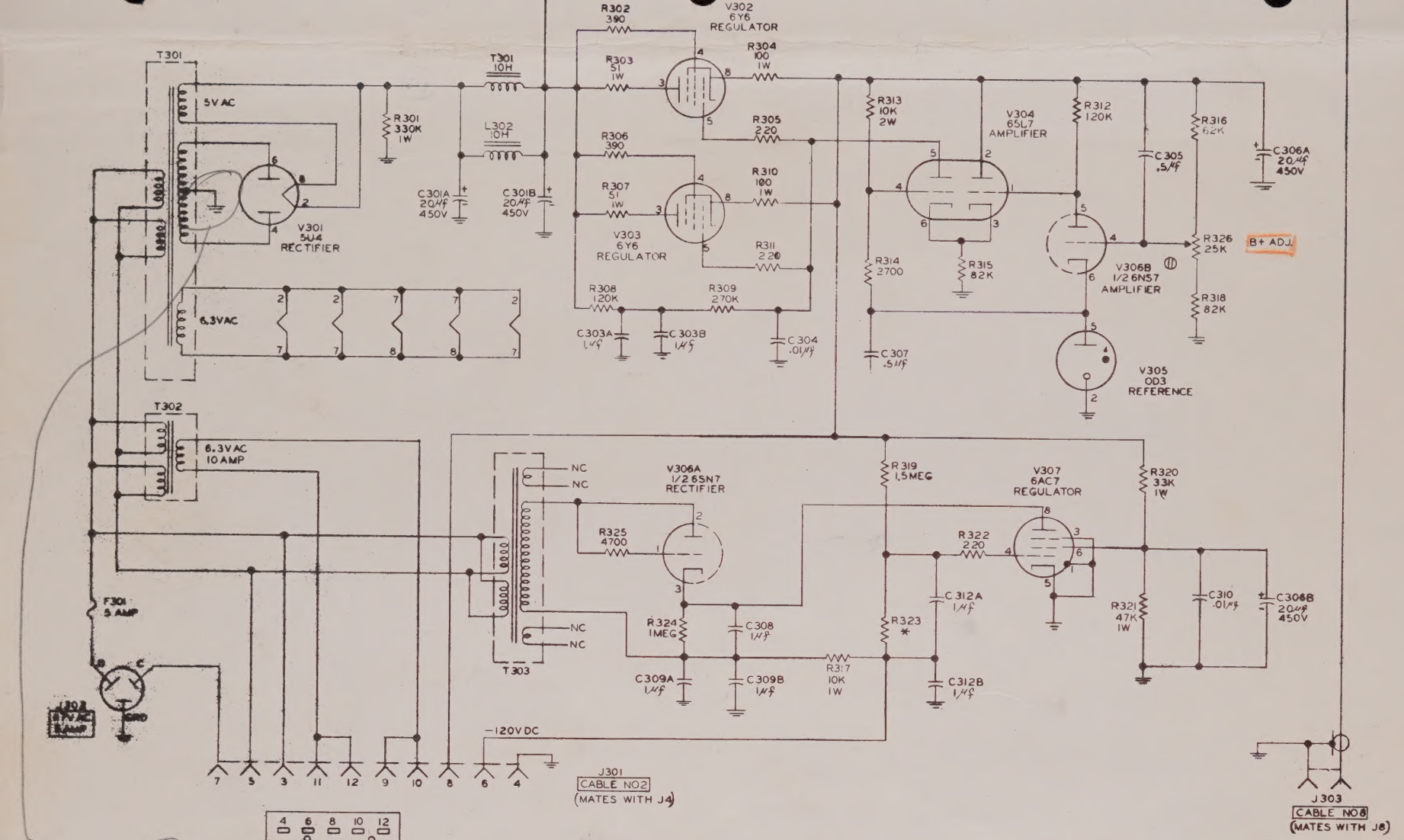
DWG. SYMBOL NO.	NAME OF PARTS AND DESCRIPTION	FUNCTION	KAY PART NO.
XV-16	Socket: same as XV2	Socket for V-16	
XV-17	Socket: same as XV2	Socket for V-17	
XV-18	Socket: same as XV2	Socket for V-18	
XV-19	Socket: same as XV2	Socket for V-19	
Z-1	Filter Assembly: 35 kc; 1.364-35 kc	Bandpass filter	1364-35KC
	Loudspeaker, Permanent magnet: 5 in.	Loudspeaker	1003
	Modulator Assembly:	Modulator	7198

7-1d Power Supply, Schematic C-7976-A

	Power Supply	To develop required filament and plate voltages for the amplifier-analyzer and ac voltage for the recorder.	
C-301	Capacitor, fixed, electrolytic: dual, 20 mf, 500 VDCW	Plate supply filter capacitor (chassis top).	6355-11
C-302	Not used		
C-303	Capacitor, fixed, paper dielectric: dual, 1 mf, 600 VDCW, +40% -15%, bathtub, hermetically sealed	Voltage regulator filter capacitor (chassis rear).	1748-T
C-304	Capacitor, fixed, ceramic dielectric: 0.01 mf, 500 VDCW	Voltage regulator filter capacitor for XV304	6360-6
C-305	Capacitor, fixed, electrolytic: 0.5 mf; 600 VDCW; bathtub	Voltage regulator filter capacitor (chassis front)	325
C-306	Capacitor, fixed, electrolytic: dual; 20 mf; 450 VDCW	Plate supply bleeder filter capacitor (chassis top) C306. Low voltage supply filter (chassis top) C311.	6355-10
C-307	Capacitor, same as C-305	Voltage regulator V305 bleeder (chassis front)	
C-308	Capacitor, fixed, electrolytic: 1 mf; 600 VDCW	Low voltage rectifier cathode resistor bypass (chassis rear)	326
C-309	Capacitor, same as C-303	Low voltage supply filter (chassis rear)	
C-310	Capacitor, same as C-304	Low voltage regulator bypass (XV307)	
C-311	Not used		
C-312	Capacitor, same as C-303	Low voltage supply filter (chassis front)	
F-301	Fuse, cartridge: 5 amp; 250V	Power fuse (chassis top)	246
J-301	Connector, receptacle, electrical: 10 pin; male; large	Power supply cable receptacle (chassis rear panel); cable #2	229
J-302	Connector, receptacle, electrical: 3 terminal; twist lock	AC power cable receptacle (chassis rear panel); cable #9 (for rack mounted configuration) cable #10 (for console mounted configuration)	7914
J-303	Connector, receptacle, electrical: shielded microphone connector; female	Large drum cable receptacle; cable #8	7514
L-301	Coil, radio frequency: 10 henry	Plate supply filter choke	323B/KC6353
L-302	Coil, same as L-301		

DWG. SYMBOL NO.	NAME OF PARTS AND DESCRIPTION	FUNCTION	KAY PART NO.
R-301	Resistor, fixed, composition: 330,000 ohms, 1 W	V-301 Bleeder XV301	3341-G
R-302	Resistor, fixed, composition: 390 ohms; ½ W	Regulator screen grid resistor XV302	3911-E
R-303	Resistor, fixed, composition: 51 ohms; 1 W	Regulator plate resistor XV302	5105-G
R-304	Resistor, fixed, composition: 100 ohms; 1 W	Regulator cathode resistor XV302	1011-G
R-305	Resistor, fixed, composition: 220 ohms; ½ W	Regulator grid resistor; XV302 to XV304	2211-E
R-306	Resistor, same as R-302	Regulator screen grid resistor XV303	
R-307	Resistor, same as R-303	Regulator plate resistor XV303	
R-308	Resistor, fixed, composition: 120,000 ohms; ½ W	Regulator filter resistor; connects between R-309 and 450V buss	1241-E
R-309	Resistor, fixed, composition: 270,000 ohms; ½ W	Regulator filter resistor; XV303 to R-308	2741-E
R-310	Resistor, same as R-304	Regulator cathode resistor XV303	
R-311	Resistor, same as R-305	Regulator grid resistor; XV303 to XV304	
R-312	Resistor, same as R-308	Regulator grid resistor; XV306	
R-313	Resistor, fixed, composition: 10,000 ohms; 2 W	Regulator coupling resistor XV304	1041-H
R-314	Resistor, fixed, composition: 2700 ohms; ½ W	Regulator grid resistor; XV305	2721-E
R-315	Resistor, fixed, composition: 82,000 ohms: 1 W	Regulator cathode resistor; XV304 to ground	8231-G
R-316	Resistor, fixed, composition: 62,000 ohms; ±5%, ½ W	Regulator bleeder resistor: XV306 to R326	6235-G
R-317	Resistor, fixed, composition: 10,000 ohms; 1 W	Low voltage supply filter resistor on terminal strip of chassis rear	1031-G
R-318	Resistor, fixed, composition: 82,000 ohms; ½ W	Regulator bleeder resistor: XV307 to R326	8231-E
R-319	Resistor, fixed, composition: 1.5 mego; ½ W	Low voltage supply coupling resistor on terminal board near R326	1551-E
R-320	Resistor, fixed, composition: 33,000 ohms; 1 W	Low voltage regulator screen resistor XV307	3331-G
R-321	Resistor, fixed, composition: 47,000 ohms; 1 W	Low voltage regulator screen resistor; XV301 to C306	4731-G
R-322	Resistor, same as R-305	Low voltage regulator grid coupling resistor XV307	
R-323	Resistor, fixed, composition: 560,000 to 750,000 ohms; ±5%, ½ W; factory selected value; carbon	Low voltage regulator grid leak resistor across C312	
R-324	Resistor, fixed, composition: 1 mego; ½ W	Low voltage rectifier cathode resistor across C308	1051-E
R-325	Resistor, fixed, composition: 4700 ohms; ½ W	Low voltage rectifier grid resistor XV306	4721-E
R-326	Resistor, variable: 25,000 ohms; 2 W	Regulator adjust; chassis top	114
R-327	Resistor, fixed, wirewound: 2,000 ohms; 5 W	+450 volt output dropping resistor	2025-J

DWG. SYMBOL NOL	NAME OF PARTS AND DESCRIPTION	FUNCTION	KAY PART NO.
T-301	Transformer, power, step-up:	High voltage supply transformer chassis top	320/KP6332
T-302	Transformer, power, step-down:	Filament transformer chassis bottom	322/KP6930
T-303	Transformer, power, step-down:	Low voltage supply transformer chassis top	319/KP6645
V-301	Electron tube: Type 5U4	Plate supply rectifier	5U4
V-302	Electron Tube: Type 6Y6	Regulator tube	6Y6
V-303	Electron Tube: same as V302		
V-304	Electron Tube: Type 6SL7	Regulator control tube	6SL7
V-305	Electron Tube: Type 0D3	Voltage regulator	0D3
V-306	Electron Tube: Type 6SN7	Low voltage rectifier and regulator amplifier	6SN7
V-307	Electron Tube: Type 6AC7	Low voltage regulator tube	6AC7
XF-301	Fuseholder:	F301 holder; chassis top	245
XV-301	Socket, electron tube: octal	Socket for V301	253
XV302	Socket: same as XV301	Socket for V302	
XV-303	Socket: same as XV301	Socket for V303	
XV-304	Socket: same as XV301	Socket for V304	
XV-305	Socket: same as XV301	Socket for V305	
XV-306	Socket: same as XV301	Socket for V306	
XV-307	Socket: same as XV301	Socket for V307	
	Drum Assembly, large: 12 in. diameter by 7½ in. high overall dimensions	For preparing charts	7387
	Belt, round:	Leadscrew drive belt	7407
	Spring, garter, extension:	Paper retainer	7395



NOTES

UNLESS INDICATED OTHERWISE
ALL RESISTANCE VALUES ARE IN OHMS, 1/2W
ALL CAPACITANCE VALUES ARE IN μf

RECPTACLES VIEWED FROM RECEPTACLE SIDE

* INDICATES FACTORY SELECTED VALUE BETWEEN 560K AND 750K OHMS

ⓓ INDICATES SCREWDRIVER ADJUSTED CONTROL

POWER SUPPLY, C-7976-A